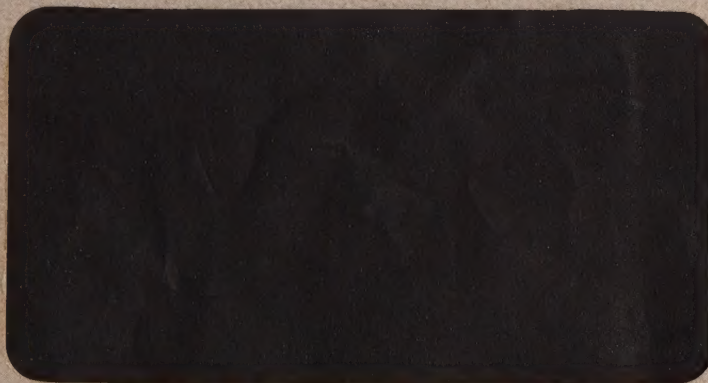


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HANDBOOK OF OPERATING INSTRUCTIONS

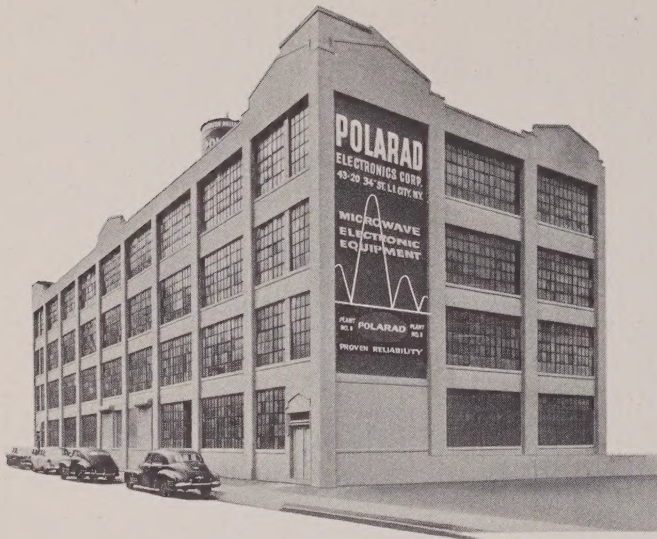


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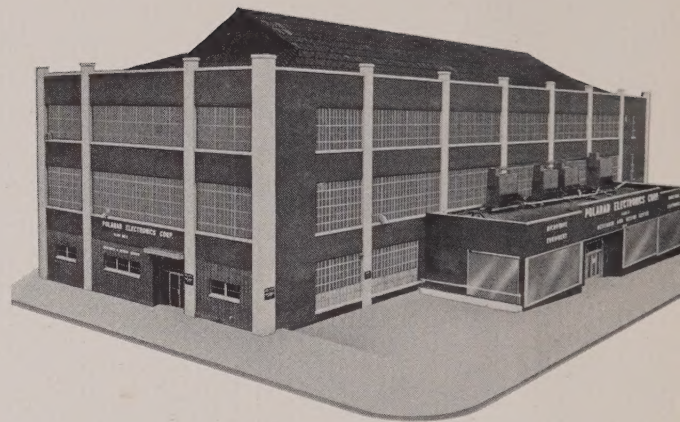
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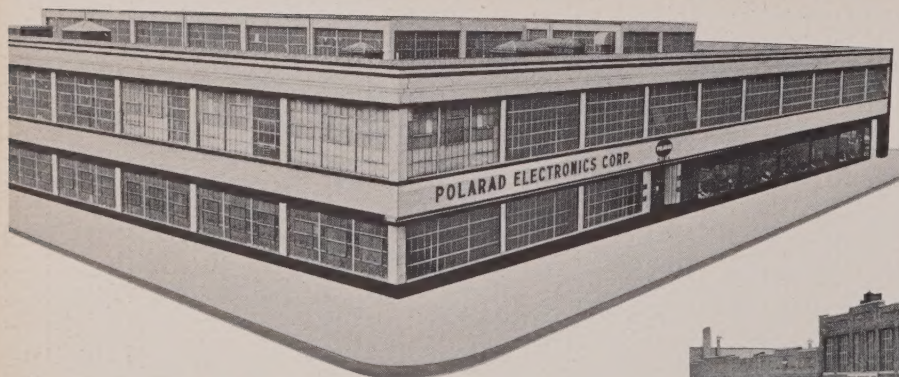
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PLANT 3





INSTRUCTION MANUAL

SPECTRUM ANALYZER MODEL TSA-W

(SERIAL NO. 131 AND UP)

POLARAD ELECTRONICS CORPORATION

43-20 34th STREET • LONG ISLAND CITY 1 • NEW YORK, N. Y.

Warranty

Polarad Electronics Corporation warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, fuses or batteries, which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which on our examination shall disclose to our satisfaction to have been thus defective.

Polarad Electronics Corporation reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of the Polarad Electronics Corporation, and Polarad neither assumes nor authorizes any other person to assume for them any other liability in connection with the Sales of Polarad's instruments.



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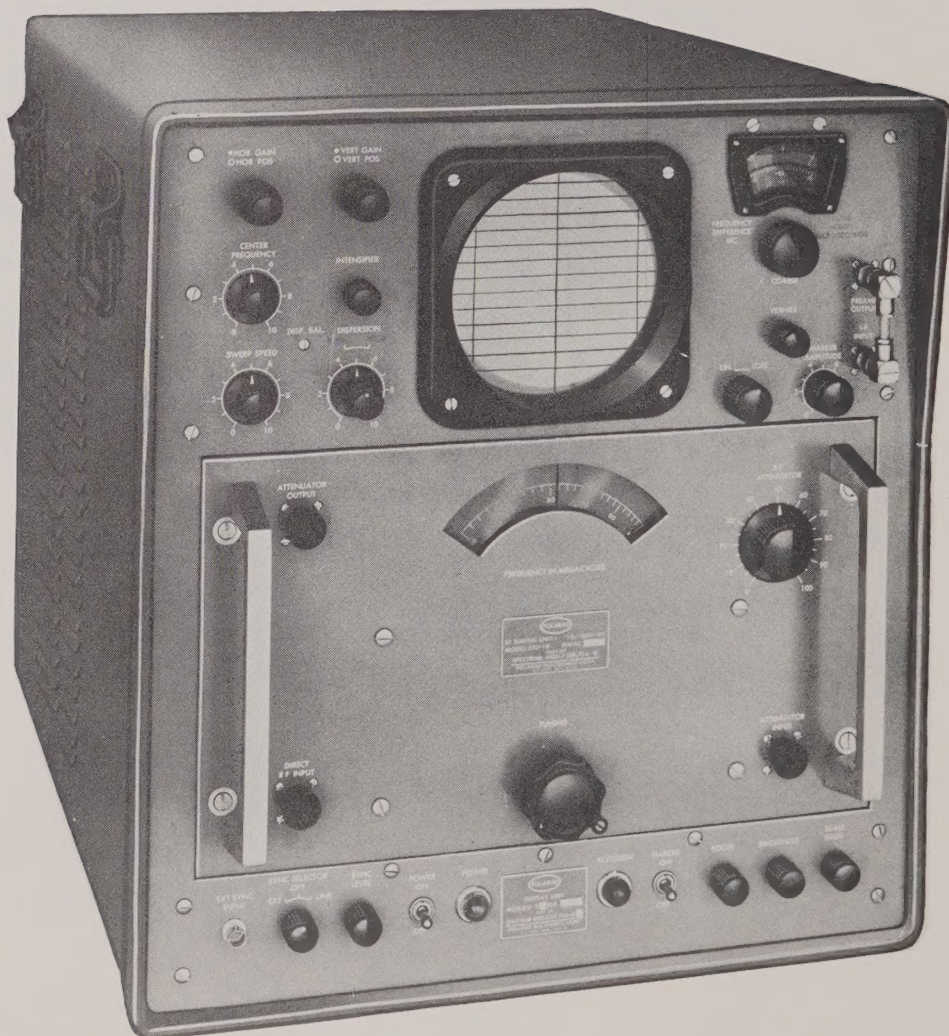
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WARNING

APPLICATION OF POWER TO THIS EQUIPMENT RESULTS IN VERY HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OBSERVE ALL SAFETY PRECAUTIONS AND USE EXTREME CAUTION. DO NOT OPERATE EQUIPMENT UNLESS COMPLETELY CLOSED. BEFORE PROCEEDING WITH MAINTENANCE PROCEDURES, READ SECTION V CAREFULLY.



Model TSA-W Spectrum Analyzer

SECTION I

INTRODUCTION

1-1. SCOPE OF MANUAL.

This instruction manual contains directions for the installation, operation, and maintenance of the direct-reading table-top Spectrum Analyzer, Model TSA-W, covering the frequency range from 10 mc to 44,000 mc. In addition to these instructions, there is a listing of the technical characteristics as well as a brief theory of operation of the equipment. The unit is designed and manufactured by Polarad Electronics Corporation, Long Island City 1, New York.

1-2. USES OF THE MODEL TSA-W SPECTRUM ANALYZER.

a. The TSA-W Spectrum Analyzer permits rapid and accurate measurement, and spectral display of the frequency distribution of energy in an rf signal in the 10 mc to 44,000 mc range. Cw and pulsed radio signals are presented visually as a plot of voltage vs. frequency.

b. Specific uses of the equipment are:

- (1) Observing and measuring side bands associated with amplitude and frequency modulated signals.
- (2) Determining the presence and measuring the

frequency of radio and/or radar signals.

(3) Determining the type of modulation in radio and/or radar signals.

(4) Checking and observing the tracking of rf components of a radar system, for example, tracking transmitter and receiver.

(5) Determining rf pulse characteristics.

- | | |
|--------------------------|-------------------------|
| (a) Frequency modulation | } By Spectrum Analysis. |
| (b) Pulse width | |
| (c) Pulse shape | |

(6) Checking the spectrum of pulsed magnetron oscillators, to determine pulse characteristics and to check frequency pulling.

(7) Measuring noise spectra.

(8) Checking the frequency difference and/or spectrum of two rf signals.

(9) Checking frequency relationships of multi-frequency transmitters, for example DME transmitters.

(10) Checking for parasitic oscillations.

(11) Testing for interference sources throughout frequency range from any electrical equipment.

(12) Checking transmitter or signal generator for continuous output throughout its tuning range (checking for "holes").

(13) Frequency drift of oscillators.

(14) Locating sources of rf leakage.

(15) Indicator for frequency standards.

SECTION II

DESCRIPTION

2-1. GENERAL.

The Polarad Model TSA-W Spectrum Analyzer is a laboratory instrument consisting of a complex super-heterodyne receiver working into a cathode-ray display. Signals in the frequency range from 10 mc to 44,000 mc may be analyzed. It comprises the main chassis, Model DU-W, and one of the five replaceable R-F Tuning Units, STU-1W, 2W, 3W, 4W, or 5W. Tuning Unit STU-1W covers the range from 10 mc to 1,000 mc; Tuning Unit STU-2W from 910 mc to 4,560 mc; Tuning Unit STU-3W from 4,370 mc to 22,000 mc; Tuning Unit STU-4W from 21,000 mc to 33,000 mc; and Tuning Unit STU-5W from 33,000 mc to 44,000 mc. The R-F Tuning Unit receives rf signals and converts them to an intermediate frequency of 160 mc, which is amplified, further heterodyned, and detected by the various circuits within the Model DU-W. Signals detected are presented on a cathode-ray tube screen as a plot of voltage versus frequency, with voltage on the vertical axis and frequency on the horizontal axis. Controls are provided on the front

panel for continuously adjusting the spectrum width, observed on the screen, from a band of frequencies as narrow as 200 kc to a band as wide as 70 mc, as desired. The Model DU-W consists of six subchassis secured together on a single frame. In operation, a tuning unit is inserted into the frame. All required voltages are provided by four electronically regulated power supplies and one unregulated supply incorporated into the main chassis. The unit is portable and designed for either bench, wagon, or rack mounting.

2-2. TECHNICAL CHARACTERISTICS.

Frequency Range:

With R-F Tuning Unit	
STU-1W	10 mc to 1,000 mc.
With R-F Tuning Unit	
STU-2W	910 mc to 4,560 mc.
With R-F Tuning Unit	
STU-3W	4,370 mc to 22,000 mc.
With R-F Tuning Unit	

STU-4W 21,000 mc to 33,000 mc.
 With R-F Tuning Unit
 STU-5W 33,000 mc to 44,000 mc.
 Spectrum Display . . . Voltage on the vertical axis
 versus frequency on the
 horizontal axis.

Resolution Band-
 width (3 db) 7 kc at low and 50 kc at high
 dispersion settings.

Frequency
 Dispersion 200 kc to 70 mc in two bands,
 100 kc to 7 mc and 1 mc to
 70 mc.⁺

Sweep Repetition
 Rate 1 cps to 30 cps, adjustable.

Sweeper Center
 Frequency 224 mc.

Synchronization Either line frequency inter-
 nal, negative external
 pulse, or free running.

Intermediate Frequencies:
 1st i-f Preamplifier and wide band
 amplifier centered at 160
 mc with a bandwidth of 70
 mc (3 db).

2nd i-f 64 mc.
 3rd i-f 6 mc.
 4th i-f 500 kc.

Frequency Marker . . . 160 ±40 mc.

R-F Tuning Dial
 Accuracy ±1% of dial frequency.
 STU-1W (only)* . . . ±1% of local oscillator
 frequency.

Sensitivity (minimum
 discernible signal):
 R-F Tuning Unit
 STU-1W Low range: -85 dbm.
 High range: -80 dbm.

R-F Tuning Unit
 STU-2W Low range: -85 dbm.
 High range: -75 dbm.

R-F Tuning Unit
 STU-3W Low range: -77 dbm.
 High range: -65 dbm.

R-F Tuning Unit
 STU-4W -57 dbm.

R-F Tuning Unit
 STU-5W -50 dbm.

Attenuation:
 R-F (STU-1W, STU-2W,

STU-3W only) 100 db, continuously vari-
 able.

I-F 50 db, continuously vari-
 able.

Input Impedance 50 ohms (nominal).

Max. R-F Power Input
 (through attenuator). . 250 milliwatts.

Power Input. 400 watts at 115 or 230 volts
 ±10 volts, 50 to 60 cps.

Tube Complement:
 DU-W 4-5R4; 2-807; 5-6AU6;
 6-0A2; 1-6X4; 2-6AS7G;
 1-6AR6; 2-1X2A; 1-5ADP7;
 2-6BA7; 1-6AS6; 2-12AT7;
 1-6J4; 2-6AK5; 2-6AG5;
 2-12AU7; 2-6BZ7; 3-6BC4;
 4-5718; 1-6AQ5; 3-6AN8;
 2-6BC7.
 STU-1W 1-6AF4A; 1-1N21B; 3-6AM4;
 or 6AM4.
 STU-2W 1-5837 or 6BM6; 1-6X4;
 1-1N21B.
 STU-3W 1-5721; 1-6X4; 1-1N26.
 STU-4W 1-5721; 1-6X4; 1-1N26.
 STU-5W 1-5721; 1-6X4; 1-1N53.

Dimensions: 17-1/8 in. wide x 19-1/2 in.
 high x 23-1/8 in. deep.

Weight: 170 pounds; 225 pounds
 crated.

2-3. EQUIPMENT SUPPLIED.

The equipment supplied with the Model TSA-W Spec-
 trum Analyzer is listed in Table I.

TABLE I. EQUIPMENT SUPPLIED

Item	Part or Model No.
Spectrum Analyzer main chassis	Polarad Model DU-W
R-F Tuning Unit*	Polarad Model STU-1W, STU-2W, STU-3W, STU-4W, and STU-5W.
Spanner Wrench	J. H. Williams, #482
Type N Adapter	Polarad CSIJ1700**
Waveguide Adapters	Polarad C20347**; BP24550**; BP22330***; BP22331***

* Model TSA-W includes one R-F Tuning Unit.

** Supplied with Model STU-3W only.

*** Supplied with Model STU-4 only.

+ Except in the STU-1W, where frequency dispersion is 200 kc to 5 mc below 55 mc; and 25 mc maximum from 55 to 1000 mc.

* Because of the narrow dispersion used with the STU-1W the marker oscillator error should be taken into account when setting the dispersion and reading frequency difference.

SECTION III

OPERATION

3-1. OPERATING CONTROLS.

All operating controls are located on the front panel. Table II lists the controls and their functions.

TABLE II. OPERATING CONTROLS AND CONNECTIONS

Controls or Connections	Function	Controls or Connections	Function
● HOR GAIN	Varies the gain of the horizontal deflection amplifier and hence the length of the horizontal trace on the cathode-ray tube screen.	SYNC SELECTOR	Determines the type of synchronization, power line frequency or external.
0 HOR POS	Shifts the trace left or right on the cathode-ray tube screen.	SYNC LEVEL	Varies sync amplitude to lock the sweep generator.
● VERT GAIN	Controls sensitivity of the i-f amplifier and thereby the display height.	POWER Switch	Closes the circuit in the primary of the power transformers to apply ac power.
0 VERT POS	Shifts the trace up or down on the cathode-ray tube screen.	POWER pilot light	Indicates that power is applied to energize the system, except the klystron power supply.
CENTER FREQUENCY	Controls the center frequency of the sweeper.	KLYSTRON pilot light	Indicates completion of the 60-second delay cycle and application of power to the klystron power supply*.
INTENSIFIER	Sets the amount by which the signal on the cathode-ray tube screen is intensified.	MARKER ON-OFF	Applies operating power to the marker oscillator within the equipment.
SWEEP SPEED	Permits adjustment of sweep repetition rate, within the limits of 1 to 30 cycles per second.	FOCUS	Focuses the trace on the scope screen.
DISPERSION Switch	Selects the dispersion range. LOW, 100 kc to 7 mc; HIGH, 1 mc to 70 mc.	BRIGHTNESS	Sets the general brightness level of the trace on the cathode-ray tube screen.
DISPERSION Control	Varies the frequency sweep-width.	SCALE ILLUM	Controls illumination of the graticule.
DISP. BAL.	When properly adjusted, produces the same center frequency in both dispersion ranges.	EXT SYNC INPUT	External sync input connection.
FREQUENCY DIFFERENCE MC - COARSE	Permits setting of the marker pip within plus or minus 40 mc of the i-f center frequency.	TUNING	Controls the operating frequency, as indicated on the direct-reading frequency dial.
FREQUENCY DIFFERENCE MC - VERNIER	Provides a fine control range of ± 1.0 mc.	R-F ATTENUATOR**	Attenuates the incoming signal down to 100 db, adjustable.
PULSE WIDTH, MICROSECONDS	Permits the use of the marker to measure the width of a rectangular pulse directly.	ATTENUATOR** R-F INPUT	R-F input connection for high level signal (greater than -30 dbm) to be applied through the attenuator.
FINE		DIRECT R-F INPUT	R-F input connection for low level signal, utilizing maximum sensitivity of instrument.
LIN. -LOG. Switch	Selects either linear or logarithmic vertical display.	ATTENUATOR OUTPUT (Connector)	In the Models STU-1W and STU-3W a patch is required to feed the signal from the attenuator to DIRECT R-F INPUT. This connector found in the Models STU-1W and STU-3W only.
MARKER AMPLITUDE	Varies the height of the marker pip when the MARKER ON-OFF switch is in the ON position.		
PREAMP OUTPUT	Makes available the signal from the preamplifier.		
I-F INPUT	Makes available the input to the wide band amplifier.		

* STU-2W through STU-5W only.

** STU-1W through STU-3W only.

3-2. OPERATING PROCEDURE.

a. Setting Up the Equipment.

CAUTION

THE EQUIPMENT MAY BE DAMAGED IF OPERATED AT 230 VOLTS WHEN SET FOR 115-VOLT OPERATION. EXAMINE THE TAG ATTACHED TO THE POWER SWITCH ON FRONT PANEL AND NOTE THE INITIAL FACTORY SETTING. THE SETTING MAY BE CHECKED BY REMOVING THE DUST COVER AND EXAMINING THE POSITION OF THE CONTROL SWITCH ON THE LEFT HAND SIDE OF THE CHASSIS.

(1) Connect plugs P1502 and P104, which terminate the 2 cables from the main chassis, to the power and signal jacks on the rf tuning unit. Connect power cord to ac source.

(2) Turn the POWER ON-OFF switch to its ON position. The POWER indicator should light. After a 60-second delay, the KLYSTRON indicator should light.* Allow a 10 minute warmup period.

(3) Set the BRIGHTNESS, VERT POS, VERT GAIN, HOR POS, HOR GAIN, and FOCUS controls to produce a sweep baseline, centered on the screen.

(4) Set the DISPERSION control maximum clockwise and the VERT GAIN control to produce a noise display approximately 1/4 in. high on the screen.

(5) Turn the MARKER ON-OFF switch to its ON position and the MARKER AMPLITUDE control completely clockwise. Turn the FREQUENCY DIFFERENCE controls to zero. This operation places the marker pip at the electrical center of the display. If the marker pip is not visible or is not in the center of the display screen, vary the CENTER FREQUENCY control until the pip is properly centered on the display baseline. Set the MARKER AMPLITUDE control to give desired marker height.

(6) Connect the signal under test to the DIRECT R-F INPUT (if signal is less than -30 dbm) or to the ATTENUATOR R-F INPUT** (if signal is greater than -20 dbm). Check to see that the rf tuning unit being used falls within the range of the signal. (See paragraph 2-2.)

(7) Rotate the TUNING control until a pip, representing the incoming rf signal, appears at the center of the screen. If the display is excessively large, adjust the VERT GAIN control to simultaneously reduce gain and suppress noise. Adjust the R-F ATTENUATOR control for a suitable signal amplitude. If the signal amplitude is still excessive with maximum rf attenuation, adjust the VERT GAIN control.

* STU-2W, STU-3W, STU-4W, and STU-5W. only.

** In the Models STU-1W and STU-3W only, it is also necessary to patch from ATTENUATOR OUTPUT to DIRECT R-F INPUT.

(8) Adjust the spectrum dispersion by varying the DISPERSION control. This control sets the band of frequencies covered by the sweep-oscillator circuit. Frequency dispersion can be varied within the limits of 200 kc to 70 mc in two bands 200 kc to 7 mc and 1 mc to 70 mc except in the Model STU-1W R-F Tuning Unit which permits a maximum dispersion of 25 mc above 50 mc. Below 50 mc the dispersion should be reduced to less than 5 mc by switching to the low dispersion band. ***

(9) Set the marker oscillator dials to zero. Adjust the MARKER AMPLITUDE control for a visible pip on the screen. Switch to the LOW DISPERSION range and adjust the CENTER FREQUENCY control to center the pip. Turn the DISPERSION control gradually counterclockwise for a more critical adjustment. Switch to the HIGH DISPERSION position and adjust the DISP. BAL. control to center the pip with the DISPERSION control set to maximum.

b. Determining the Frequency of an Applied R-F Signal.

The spectrum display is designed to indicate increasing frequency of input signal from left to right. Note that rotating the frequency dial to a higher frequency with a fixed signal will cause the signal on the screen to move left.

(1) Set the marker to the electrical center of the display as directed in step (5) of the previous subparagraph.

(2) Slowly rotate the TUNING control until the signal pip merges with the marker pip. Read the frequency of the incoming rf signal directly from the frequency dial. It is important to determine which of the calibrated scales is to be read and to distinguish between the true signal and the image. Proceed as follows: Set the DISPERSION control maximum clockwise and rotate the tuning dial towards the higher frequency and note the movement of the pip. If the pip moves to the left, it is the true signal. If the pip moves to the right, it is the image. The true signal pip will then be found 320 mc higher than the image. If the signal pip moves off scale, read the high range scale. If the signal pip moves 10 mc, read the low range scale. If the pip remains stationary on the screen it is a spurious response due to a signal falling within the i-f pass band. (125-195 mc).

c. Determining the Width of any Lobe of a Signal Spectrum.

(1) Note that the FREQUENCY DIFFERENCE MC control is calibrated from minus 40 to plus 40 megacycles. Vary the FREQUENCY DIFFERENCE MC dial so that the marker pip is coincident with one edge of the lobe whose width is to be measured. Record the setting of the dial.

***Because of the narrow dispersion used with the STU-1W the marker oscillator error should be taken into account when setting the dispersion and reading frequency difference.

(2) Rotate the FREQUENCY DIFFERENCE MC dial so that the marker pip is coincident with the other edge of the lobe being measured. Record the setting of the dial.

(3) The difference in megacycles between the settings of the FREQUENCY DIFFERENCE MC dial in steps (1) and (2) is the width of the particular lobe appearing in the display.

(4) To operate the vernier dial set the COARSE-FREQUENCY DIFFERENCE MC dial to zero and proceed as above.

d. Measuring Frequency Difference.

The procedure described in paragraph c is also applicable to measuring frequency difference between any two signals appearing in the display.

e. Measuring the Incidental FM of an Applied Signal.

To measure the incidental fm of a signal applied to the spectrum analyzer proceed as follows:

(1) Apply the signal to the input of the spectrum analyzer and set the controls to view the resultant pulse.

(2) Vary the DISPERSION control to set the main lobe to three-quarters of the screen diameter.

(3) Use the marker pip and calibrate the bandwidth from one side of the scale to the other. Divide the bandwidth figure by 10 to find the frequency change-per-scale division.

(4) Set the SWEEP SPEED control to minimum (maximum counterclockwise).

(5) Draw two lines to indicate the pulse envelope. (See lines (A) and (B) of figure 1.) Draw a horizontal

line (C) from one side of the envelope to the other. Drop two vertical lines (D) and (E) to the base from the two points on the inner edges of the envelope crossed by the horizontal line (C).

(6) Count the number of divisions between lines (D) and (E) at the base. Use the frequency change-per-scale division derived in step (3) to calculate the frequency change. This frequency change represents the incidental fm of both the applied signal and that inherent within the spectrum analyzer.

(7) To determine the fm of the applied signal it will be necessary to measure the incidental fm of the spectrum analyzer and to take this incidental fm and its phase angle into consideration. To measure the incidental fm of the analyzer, follow the procedure for measuring the incidental fm of an applied signal except that the signal applied should be the output of a cw generator known to be free of fm.

f. Spectra of Pulse-Modulated Signals.

The pulse-width calibration of the marker applies to amplitude modulated rectangular pulses. The following procedure is to be followed:

(1) Set both the coarse and vernier dials to zero.

(2) Tune the rf signal to set the peak of the main lobe coincident with the marker.

(3) Turn the marker to the next zero and read pulse-width on the orange dial.

(4) Alternatively, the rf signal may be tuned to set one of the zeroes coincident with the marker zero and then tune the marker to the succeeding minor lobe zero.

Figure 2 illustrates the spectra resulting from certain types of pulse modulation.

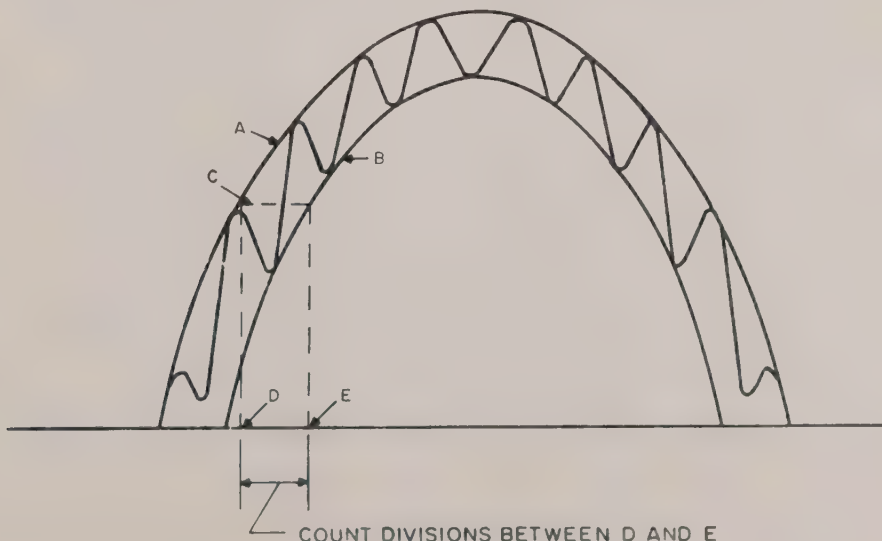


Figure 1. Measuring Incidental FM

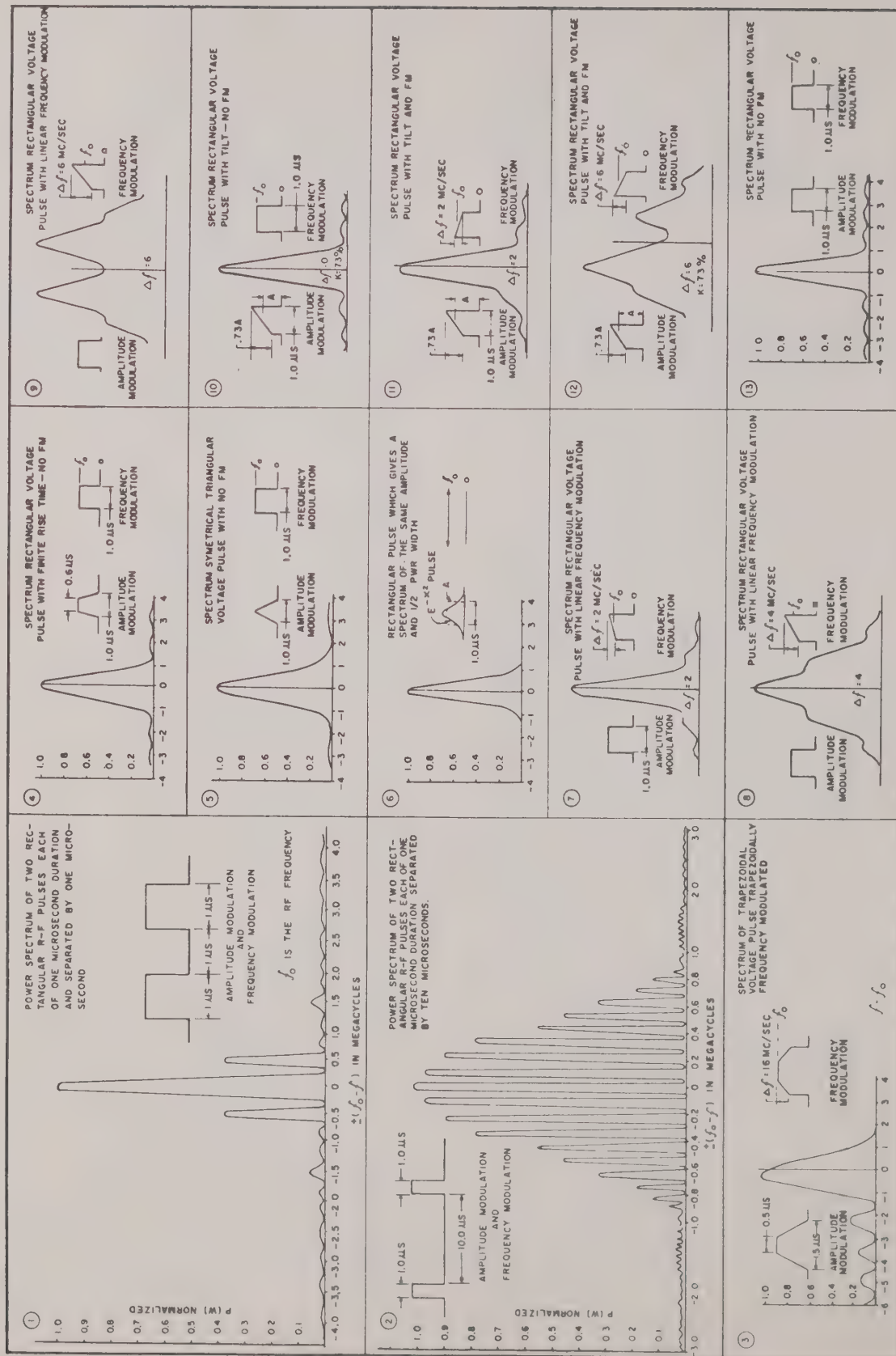


Figure 2. Applied Pulse vs Power Spectra

SECTION IV

THEORY OF OPERATION

4-1. GENERAL.

The principles of operation of the Polarad Model TSA-W Spectrum Analyzer may be understood from the block diagram of figure 3. The Models STU-2W, STU-3W, STU-4W, and STU-5W R-F Tuning Units each contain an external cavity klystron local oscillator, a crystal mixer, a tracking potentiometer and adjustment panel, and a mechanical drive system. The Model STU-1W contains a local oscillator using a triode tube in a tuned transmission line circuit, a crystal mixer, and a mechanical drive system. The units are each tuned manually by rotating the single TUNING knob, located at the center of each front panel. In the Model STU-1W, rotation of the TUNING knob drives a shorting element across the tuned transmission line and, simultaneously, the tuning dial. In the other units, rotation of the tuning knob simultaneously drives a noncontacting choke within the oscillator cavity, a tracking potentiometer for changing reflector voltage automatically and a tuning dial. The dial indicates frequency in megacycles accurately to $\pm 1\%$. *** The main chassis, Model DU-W, consists of broad band and narrow band i-f amplifiers, a variable-frequency marker oscillator, a sweeper circuit, a 5-inch cathode-ray oscilloscope with its associated driving circuits and four power supplies (fig. 13). The Models STU-1W, STU-2W and STU-3W R-F Tuning Units cover their respective ranges in two bands* each. Signals in a 70 mc** bandwidth, centered at the frequency to which the unit is tuned, are received and converted to 160 mc (the first intermediate frequency). This 160 mc signal is fed by coaxial cable to the preamplifier and then to the wide band amplifier, both of which are located in the main chassis, Model DU-W. The output of the wide band amplifier is fed into the mixer of the wide band amplifier. The local oscillator swept injection of the 224 mc sweeper is also fed into the mixer of the wide band amplifier. The resultant i-f center frequency of 64 mc is amplified by the narrow band amplifier. The bandwidth of the last i-f stage is either 7 kc or 50 kc, depending on whether the DISPERSION range switch is set to the LOW or HIGH position. In addition to the usual scope con-

* STU-1W - 10 mc to 400 mc (low range); 400 to 1,000 mc (high range).

STU-2W - 910 mc to 2,200 mc (low range); 1,980 mc to 4,560 mc (high range).

STU-3W - 4,370 mc to 10,920 mc (low range); 8,900 to 22,000 mc (high range).

** Except for the Model STU-1W which has a 5 mc bandwidth in the 10-55 mc range and 25 mc above 55 mc.

*** $\pm 1\%$ in STU-1W refers to local oscillator frequency.

trols, means for adjusting the center frequency of the sweep oscillator are provided. A distinct spectrum display is obtained by beam intensification for the duration of the signal. The variable-frequency marker can be used to determine frequency differences of as little as 200 kc. It calibrates the spectrum display and helps determine frequency difference with great accuracy. A description of each of the components of Model TSA-W follows:

4-2. LOCAL OSCILLATOR.

a. Model STU-1W employs a 6AF4A triode tube in a tuned transmission line oscillator circuit. In the low range (10 mc to 400 mc), the local oscillator fundamental is tuned 160 mc above the incoming signal. In the higher band of operation (400 mc to 1,000 mc), the second harmonic is used to heterodyne with the incoming signal and is also operated 160 mc above.

The parallel transmission line operates in a $1/4$ wave mode and is tuned by changing the position of a contacting short circuit by means of the tuning dial.

b. In the Models STU-2W, STU-3W, STU-4W, and STU-5W, a reflex klystron tube is employed as the first local oscillator. In both bands#, the local oscillator frequency is 160 mc higher than the signal frequency.

The external cavity klystron oscillator functions with a $3/4$ wavelength cavity mode. The oscillator is tuned by changing the position of a non-contacting short-circuiting choke assembly within the cavity and by changing the value of the reflector voltage. The Model STU-2W R-F Tuning Unit employs the $1-3/4$ reflector mode over the frequency range from approximately 910 mc to 1,500 mc. In the vicinity of 1,500 mc, the reflector voltage becomes excessively high and mode-switching is therefore employed. At the mode switch-point a microswitch is activated by a nylon cam, on the tracking potentiometer shaft, reducing reflector voltage to the proper range for $2-3/4$ ## reflector mode operation. A friction drive is employed in the tuning mechanism. The voltage applied to the reflector electrode of the external cavity klystron tube is simultaneously tracked with the tun-

STU-4W and STU-5W have one band only.

Models STU-3W and STU-4W employ the $2-3/4$ reflector mode at 4,370 to 7,800 mc and 21,000 to 23,240 respectively; the $4-3/4$ reflector mode at about 7,800 mc and 23,240 mc respectively.

Model STU-5W employs the $4-3/4$ reflector mode over its entire range.

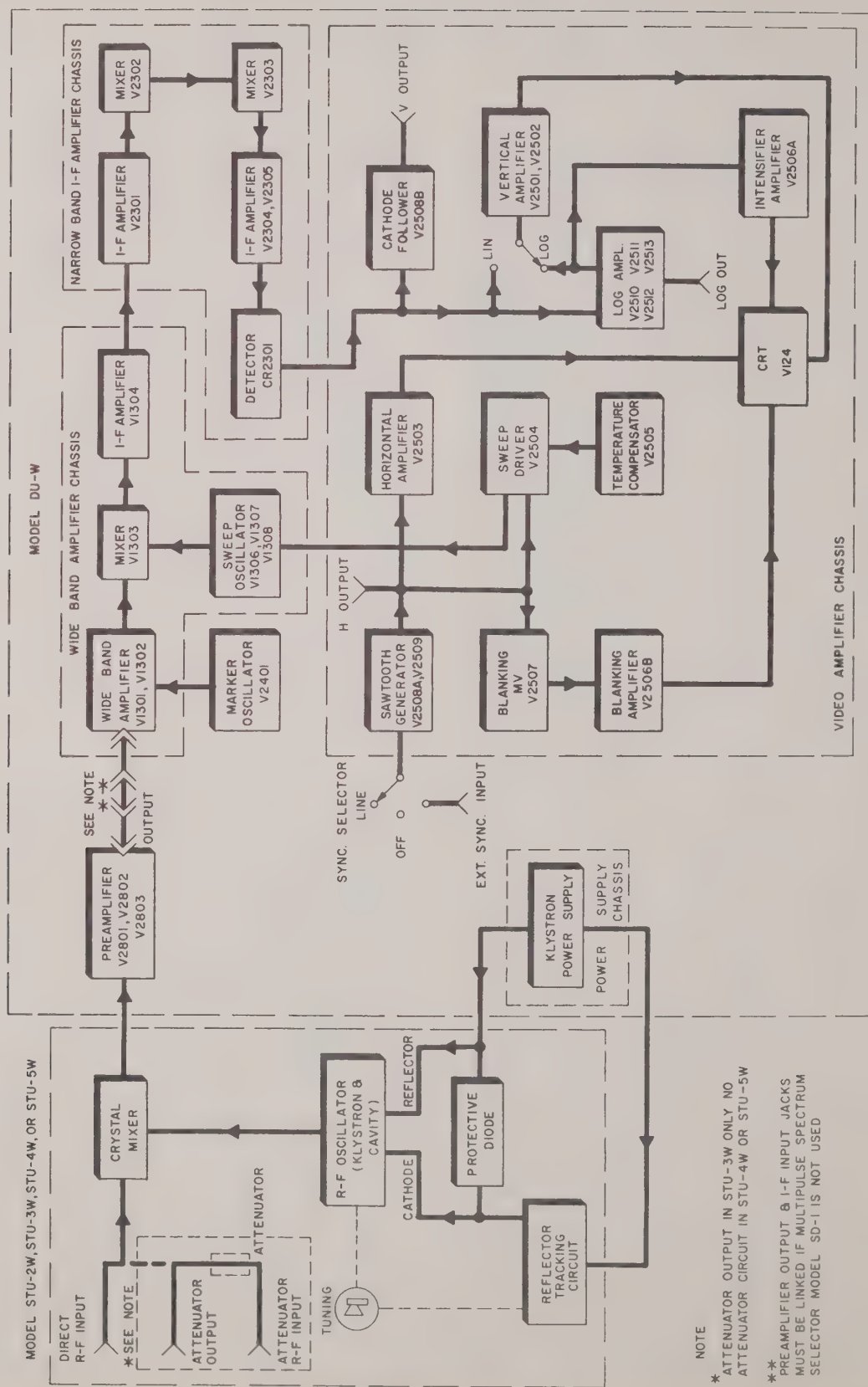


Figure 3. Block Diagram, Signal Paths, Model TSA-W

ing dial rotation by means of a tracking potentiometer. A 6X4 protects the klystron by preventing the reflector from going positive with respect to the cathode.

4-3. TUNING HEAD CRYSTAL MIXER.

a. A silicon crystal diode is employed as the mixer, which develops a beat signal of 160 mc when the fundamental frequency of the local oscillator and the applied signal in the low range of the tuning unit are coupled to its input. For example, when in Model STU-2W an rf signal of 940 mc is applied through the R-F INPUT jack to the crystal mixer, the local oscillator is tuned to produce an output frequency of 1,100 mc. The resultant difference frequency of 160 mc is fed to the input of the preamplifier and then to the wide band amplifier. +

b. When tuning over the high range, the second harmonic of the local oscillator frequency is used to beat with the incoming rf signal. This second harmonic component is actually developed in the crystal mixer, due to the mixer's non-linear characteristics. For example, when the STU-2W Tuning Unit is tuned to a signal frequency of 2,040 mc, the fundamental local oscillator frequency is 1,100 mc. The second harmonic of the oscillator frequency is then 2,200 mc. This second harmonic component beats with an incoming 2,040 mc signal to produce a difference frequency of 160 mc, which is fed to the preamplifier.

The output of the mixer is fed into a crystal matching network Z1501 provided with STU-2W, 3W, 4W and 5W to tune out the crystal output capacitance at 160 mc.

4-4. PREAMPLIFIER.

The preamplifier serves to amplify the 160 mc signal, coupled from the rf tuning unit, prior to its application to either the wide band amplifier or a Multipulse Spectrum Selector, if one is used.

The input stage comprises two grounded-grid ampli-

+ The STU-1W only, uses an additional wide band amplifier. After amplification by the STU-1W wide band amplifier, the 160 mc signal is fed through a low-pass filter and a wide band pass filter. The function of the filters is to reduce spurious response. In the 10 to 55 mc range the signal is also passed through a narrow band pass filter. When operating below 55 mc it is recommended that the dispersion be limited to less than 5 mc in order to avoid spurious signals. The DISPERSION switch should be set to the LOW position.

fier tubes (V2801 and V2802) connected in parallel. The input impedance of 50 ohms presented by the grounded-grid amplifier terminates the mixer transmission line.

An overcoupled double-tuned circuit is used to couple the grounded-grid stage to the cascode output stage (V2803). The single-tuned output circuit is stagger-damped with the overcoupled network to produce a flat response over a 70 mc band centered at 160 mc.

4-5. WIDE BAND AMPLIFIER AND SWEPT OSCILLATOR.

The signal from the preamplifier is fed to a two-stage amplifier having a bandwidth of approximately 75 mc. This amplifier consists of a grounded-grid input stage (V1301) followed by a cascode amplifier (V1302). The two stages are stagger-damped to produce the desired overall response.

The triode mixer (V1303) is followed by one stage of amplification (V1304) at 64 mc.

Two swept oscillators are used - one for low dispersion sweeps, the other for high dispersion. Saturable ferrite cores are used in both oscillator circuits. The low-dispersion oscillator (V1308) employs a Colpitts circuit and the ferrite coil is decoupled to reduce the sweep. A push-pull circuit (V1306, V1307) is employed in the high dispersion oscillator.

The ferrite cores of the oscillator tank inductances are subjected to a saturating field produced by the reactor. In this manner the frequency of the oscillator is swept as a sawtooth current flows through the reactor coils.

4-6. NARROW BAND AMPLIFIER.

The narrow band amplifier is comprised of a 64 mc stage (V2301), a converter (V2302) producing a 6 mc i-f which is followed by a 500 kc converter (V2303), and two stages of amplification (V2304 and V2305).

The oscillator section of V2302 is crystal-controlled and operated at 29 mc for second harmonic conversion. The frequency is reduced at this stage to 6 mc. The signal is then coupled to the succeeding mixer (V2303) by means of a double-tuned circuit. The oscillator section of V2303 is operated at 5.5 mc to produce a final i-f of 500 kc. Single-tuned 500 kc circuits are used in the mixer and the succeeding stage. The final stage (V2305) employs a coupling circuit to the second detector which is adjusted to produce an overall bandwidth of either 7 kc or 50 kc depending on the setting of the DISPER-

SION switch. In the HIGH position an overall bandwidth of 50 kc is realized by disconnecting the secondary of the double-tuned transformer coupling the last stage to the video detector and by coupling the detector to the transformer primary which now forms a single-tuned circuit. The video detector load is also reduced to provide proper damping and to insure an adequate video bandwidth; in the LOW position (7 kc), the detector is switched to the secondary of the transformer and the double-tuned circuit serves to reduce the bandwidth to 7 kc with a high degree of selectivity. A relay (K2301) is used for switching within the i-f strip.

4-7. OSCILLOSCOPE (VIDEO) CIRCUIT.

A detailed description of the oscilloscope (video) circuit is given in the subparagraphs that follow.

a. Sawtooth Generator. The sawtooth generator employs a phantastron (V2509) circuit and a cathode follower (V2508). The sawtooth voltage, available at the cathode follower load, is coupled to the sweeper driver stage (V2504) and to the horizontal deflection amplifier (V2503). It is also fed to connector J128 for use with external equipment. The repetition rate is variable over a range of 1 to 30 cycles per second. The phantastron may be synchronized by a pulse derived from the power line or from an external source.

b. Horizontal Deflection Amplifier. A push-pull horizontal deflection amplifier is used for this purpose (V2503). The sawtooth voltage is applied to the grid of one triode section while the centering voltage is applied to the alternate grid. Cathode coupling is used for phase inversion.

c. Vertical Deflection Amplifiers. The vertical deflection amplifier is similar to the horizontal amplifier except that pentode stages are used. A series resonant circuit, tuned to 500 kc, is placed between the deflection amplifier plates to suppress the 500 kc i-f carrier (L2501, C2501).

The signal from the second detector is applied to the control grid of V2501.

One triode section of V2508 is used as an output cathode follower to provide a voltage for use with external equipment. Its output is available at the connector J129.

d. Logarithmic Amplifier. The logarithmic amplifier incorporates a stable dc feedback amplifier (V2510, V2511), having a gain of 7, and a diode segmentation circuit (V2512, V2513). The segmentation circuit produces the logarithmic compression while

the amplifier increases the signal level prior to being compressed. Approximately equal deflection in linear and logarithmic operation is realized at full screen deflection; i.e., at this level the logarithmic compression is equal to the amplifier gain. With most signal levels, however, the deflection will be greater with the LIN.-LOG. switch in the LOG. position since the logarithmic amplifier will provide relatively higher gain for the low level signals.

The LOG. calibration is approximately 3 db per graticule division; the range of accurate calibration is 26 db. The cathode follower triode section of V2510 is used to supply an output for external use at connector J130.

e. Blanking Generator and Amplifier. The function of the blanking generator is to produce a pulse which is used to blank the CRT beam for the period when normal, linear sweep is not obtained. This includes the retrace period and the initial portion of the sweep which exhibits a step, characteristic of phantastron generators.

The blanking pulse is generated by a monostable multivibrator, V2507, triggered by the phantastron at the start of the retrace period. The width of the pulse is adjusted by means of R2553 to extend past the non-linear initial period of the sweep.

The blanking amplifier (triode section of V2506) develops a negative pulse at its plate. This pulse is coupled to the grid of the CRT.

f. Intensifier. The intensifier stage (V2506A) receives its signal from the logarithmic amplifier output. More uniform intensification is thus obtained in the linear position by virtue of the compression of spectrum pulses.

The amplified signal is applied to the cathode of the CRT. The setting of the intensifier control, R2540, determines the amount of intensification.

g. Sweeper Drive. The sweeper drive stage (V2504) supplies the sawtooth current to the reactor of the sweep oscillator. A cathode bias control, R2530, is used to set the center frequency. The dispersion is varied by the sawtooth amplitude control, R2524.

In switching to the LOW DISPERSION switch position, the low-dispersion oscillator (V1308) is energized and the high dispersion oscillators (V1306 and V1307) are turned off. A DISP. BAL. control is provided to maintain the center frequencies the same in the LOW and HIGH DISPERSION switch positions. A diode shaping circuit is used to compensate for the

sweeper non-linearity.

h. Temperature Compensator. The temperature stage serves to correct for the temperature drift which is characteristic of the saturable core material used in the sweep oscillator.

As the permeability decreases with temperature rise, an upward frequency drift would result during warmup. A thermistor in contact with the core responds to temperature increase with a decreasing resistance.

A positive dc voltage is developed across the thermistor which varies inversely with temperature. This voltage is applied to the grid of the temperature compensation stage. The current supplied by this stage varies in the direction which compensates for drift which would otherwise result.

4-8. MARKER OSCILLATOR.

The variable frequency marker oscillator subchassis is mounted directly to the right side of the cathode ray tube, as viewed from the front of the equipment. The function of the marker oscillator is to provide a variable frequency marker for calibrating the spectrum display and to help determine frequency differences. This circuit employs a 5718 tube, designated V2401, having a center frequency of 160 mc, with a tuning range 40 mc above and below this center frequency. The output of the marker oscillator is fed to the wide band amplifier. With the FREQUENCY DIFFERENCE MC tuning knob set to its zero calibration mark, and with the MARKER ON-OFF toggle switch set to its ON position the oscillator produces an output of 160 mc, which appears as a positive pip on the spectrum display. This pip marks the center of the receiver pass-band; i.e., the frequency to which the tuning unit is set. Rotating the FREQUENCY DIFFERENCE MC dial causes this marker to move along the frequency scale on the CRT screen in accordance with its tuning dial calibrations. Since the sweeper circuit is centered to produce an output of 224 mc, and the output of the marker oscillator is also applied to the mixer in the wide band amplifier, a beat frequency of 64 mc is obtained at the output of the mixer tube. This 64 mc beat signal is amplified and converted to lower i-f signals to appear as a vertical positive pip on the spectrum display screen. Setting the dial to a position other than its zero setting displaces the pip from the center of the pass-band within a range of ± 40 mc. The VERNIER control is used to measure small frequency differences about the center frequency. It has a range of ± 1 mc. To operate the vernier, the main frequency dial is set to zero and the display centered. The

vernier dial can then be used to indicate the correct frequency difference.

In addition to the frequency difference scale there is also pulse-width calibration. The calibration is in terms of pulse-width of rectangular pulses. To use it, both marker dials are set to zero and the signal is tuned in using the main tuning dial to line up the first significant point of the spectrum (usually zero or peak of main lobe). The marker is then tuned to the next significant point and the pulse-width is read directly on the dial. The amplitude of the marker oscillator output is set by the MARKER AMPLITUDE control, located at the lower right hand corner of the display unit front panel.

4-9. POWER SUPPLIES.

Three regulated power supplies, mounted on the lower subchassis of the Model DU-W (beneath the cathode ray tube), are available to provide dc power to both the Model DU-W and the rf tuning unit in use. One of the low-voltage supplies provides electronically regulated 125 and 300 volt positive outputs. Another low voltage supply provides a 150 volt negative output. The klystron power supply is electronically regulated and provides the klystron cathode* and reflector* with -325 volts and -925 volts, respectively. Model STU-1W does not use the klystron power supply. A 60-second delay before application of klystron cathode and reflector voltage is provided by delay relay K101 and hold relay K102. The red KLYSTRON pilot lamp lights upon application of the klystron voltages. The high voltage (CRT) supply provides 2,250 volts positive and 2,250 volts negative voltages; i.e., a 4,500 volt potential. Filament voltages are provided by the secondaries of transformer T103. Protection against overloads and short circuits is provided by the 5-ampere fuses in each leg of the power line.

4-10. MECHANICAL DRIVE SYSTEM. (STU-2W, STU-3W, STU-4W, AND STU-5W.)

The main drive shaft is friction driven by the TUNING knob through a planetary drive and disc which, together introduce a reduction ratio of approximately 40:1. The main shaft drives the tuning dial, the tracking potentiometer, a switch cam controls the position of the microswitch,** and the main cam. The main cam, in accordance with its contour, controls the setting of the oscillator choke assembly through a spring-loaded shaft.

* STU-3W, STU-4W, STU-5W; cathode and reflector -1,250 volts and -1,850 volts respectively.

** No switch on STU-5W.

SECTION V

MAINTENANCE

5-1. GENERAL.

While great care has been taken in the manufacture of the Polarad Model TSA-W Spectrum Analyzer and each unit is laboratory tested under strict engineering supervision, it is possible that in the course of use the unit may require checking and servicing. The discussion of principles of operation (Section IV) and tables III and IV (this section) should prove helpful in locating a defect.

WARNING

APPLICATION OF POWER TO THIS EQUIPMENT RESULTS IN VERY HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OBSERVE ALL SAFETY PRECAUTIONS AT ALL TIMES. DO NOT ATTEMPT TO REMOVE THE KLYSTRON TUBE FROM ITS CAVITY WHILE POWER IS APPLIED.

5-2. ACCESS TO THE EQUIPMENT.

CAUTION

EXERCISE CARE WHEN WITHDRAWING THE TUNING UNIT. DO NOT USE FORCE.

Access to the components of the rf tuning unit may be obtained by first setting the tuning dial to the ex-

treme high frequency end, by turning the four camloc screws (located under the handles on the front panel) a half turn counterclockwise and then carefully manipulating the tuning unit left and right as it is withdrawn from the main chassis. The two chassis may then be completely separated by disconnecting cables. Access to all other components may then be obtained by removal of the dust cover. To remove the dust cover, turn the two camloc screws (located at the rear) a half turn counterclockwise and slide the main chassis out of the dust cover.

5-3. PERFORMANCE DATA.

Performance data of the spectrum analyzer depends upon the settings of the following controls. Adjust as indicated before data is taken.

Control	Setting
POWER ON-OFF	ON
DISPERSION switch	HIGH
DISPERSION	70 mc (No. 8 on dial)
SWEEP SPEED	20 cps (No. 6 on dial)
SYNC SELECTOR	LINE
VERT GAIN	Maximum clockwise
HOR GAIN	Trace set to one screen diameter.

TABLE III. PERFORMANCE DATA

Circuit Characteristic	Input Signal or Meter	Applied to	Normal Vertical Deflection or Reading
Vertical amplifier gain.	60 cps, 1.0 volt peak-to-peak amplitude.	Jack J2513* (on video chassis). Set LIN. -LOG. switch to LIN.	Approximately 1 in. on display.
Gain from narrow band amplifier subchassis input.	64 mc (nominal), 30% modulated at 400 cps of 5 microvolts amplitude.	Jack J2301.* Set DISPERSION range switch to HIGH.	Approximately 1 in. (Tune signal source for maximum output.)
Gain from pre-amp input.	160 mc unmodulated at an amplitude of 2 microvolts.	Jack J1301* (on wide band amplifier chassis).	For minimum discernible signal.
Sweeper and i-f alignment.	Signal varied from 125 to 195 mc. (10 cps rate, high dispersion).	J1301*.	Amplitude of the pip on display screen remains within the limits of ± 3 db.

* Remove plug to make connection to jack.

TABLE III. PERFORMANCE DATA (Continued)

Circuit Characteristic	Input Signal or Meter	Applied to	Normal Vertical Deflection or Reading
Sweeper linearity.	Three unmodulated signals, 130 mc, 160 mc, 190 mc simultaneously applied.	J1301*.	Distance from 130 mc signal to 160 mc signal should be within 15% of the distance from the 160 to the 190 mc signal.
Operation of crystal in rf unit crystal.	Milliammeter.	Jack J125 (located on power supply).	Milliammeter reading greater than 0.1 ma.

* Remove plug to make connection to jack

5-4. TROUBLE SHOOTING.

Table IV lists trouble symptoms and corrective measures as an aid in localizing a defect to a particular circuit. Figure 14 illustrates the various inter-chassis cable connections.

5-4. TROUBLE SHOOTING.

Symptom	Probable Cause	Remedy
Low noise level. Spectrum appears when signal is applied.	Low gain in DU-W.	Examine tubes V2801 to V2803 and V1301 to V1303 for low gain. Replace defective tube. Check the gain of the vertical deflection amplifiers, narrow band i-f amplifier, the sweeper and i-f against the data in paragraph 5-3 to locate defective section. Substitute tubes, realign and trouble shoot defective section, as required.
Low noise level and no signal.	Defective wide band i-f amplifier, sweeper or sweeper drive circuits. 224 mc sweeper.	Check for presence of marker. If marker appears, trouble is in the preamplifier, V2801, V2802 or V2803. If the marker does not appear, check the sweeper, the sweeper drive, or wide band i-f amplifier.
Low signal-to-noise ratio.	Defective crystal mixer in rf tuner. Incorrect klystron anode voltage*.	Replace crystal. (Refer to table III for operational check.) Readjust anode voltage control tube V105 or voltage reference tubes V107 to V110 as required.

* STU-2W through STU-5W only.

TABLE IV. TROUBLE SHOOTING (Continued)

Symptom	Probable Cause	Remedy
Noise normal but no signal.	Defective crystal mixer in rf tuning unit. Klystron power supply not operating*. Defective klystron*.	Replace crystal. Readjust anode voltage control. Refer to table VI. Replace defective control tube V105 or voltage reference tubes V107 to V110 as required. Replace defective delay circuit relay K101, K102 or power supply tube as required. Refer to table VI for voltage checks. Replace klystron tube.
Poor frequency linearity.	Misalignment of 224 mc sweeper.	Refer to alignment procedure (par. 5-10).
Inability to obtain full dispersion.	Defective sweeper drive.	Replace V2504.
Poor amplitude linearity.	Wide band i-f amplifier defective or out of alignment.	Replace defective tube or realign as required.
Hum on baseline.	Low voltage power supply.	Check voltage and ripple of the +125 volt and +300 volt outputs.
Low intensity of spectrum or no trace.	High voltage (CRT) power supply.	Check to see that high voltage lead is connected to CRT. Check (CRT) power supply voltages. Check +300 volt output of low voltage supply. Check tubes V117, V120, V122, V123, and V124. Replace defective tube as required.
Spot fixed in center of screen.	Low voltage power supply.	Check +125 volt output. Check tube V114 and V115 and the setting of R147, the voltage adjustment.
No horizontal deflection.	Horizontal sweep circuits.	Check tubes V2503, V2508, V2509. Replace defective tube as required.
No vertical deflection.	224 mc sweeper, vertical deflection or narrow band i-f circuits.	Check the 224 mc sweeper. Check tubes V2501 and V2502. Check the narrow band amplifier.

* STU-2W through STU-5W only.

TABLE IV. TROUBLE SHOOTING (Continued)

Symptom	Probable Cause	Remedy
Signal "break-up". (Unusually high incidental fm).	Excessive ripple in klystron power supply*.	If fm is less than 20 kc check klystron power supply for ripple. With no external signal, use the MARKER as the applied signal and measure the incidental fm. Refer to step e., paragraph 3-2.
No marker but rf signal appears on screen.	Marker oscillator inoperative.	Replace tube V2401.
No rf sensitivity for portions of the tuning range (dead spots).	Local oscillator tube in rf tuning unit defective. Klystron power supply*. 6AK5-V1304	Recenter modes or replace the local oscillator. Check reflector voltage supply at pin 8 of jack J124 and refer to the reflector tracking procedure for the rf tuning unit.
Overheating	Dirty filter.	Clean filter.
Rotating the HOR GAIN changes the horizontal position.	Dc balance not properly set.	Readjust H. ZERO control at rear of unit.
Marker cannot be centered with the FREQUENCY control (FREQUENCY DIFFERENCE MC control set at "0".)	Defective sweeper drive.	Replace V2504.
Baseline shifts when switching from LIN. to LOG. position.	Log. amp. zero not properly set.	Readjust R-2571.

* STU-2W through STU-5W only.

5-5. POWER SUPPLY ADJUSTMENTS.

The adjustments for the power supplies are located on the right hand side of the chassis (when facing the display screen). Table V lists the adjustments, test points, and normal voltages.

TABLE V. POWER SUPPLY ADJUSTMENTS

Adjustment	Test Points	Normal Voltages
Anode volts.	Pin 7 of test jack J124 (located at rear of chassis).#	-1,250 for STU-3W, STU-4W and STU-5W.
325 V Adj.	Pin 7 of J124. #	-325 for STU-2W.*
+125 V.	Pin 3 of J124. #	+125.
+300 V.	Pin 2 of J124. #	+300.

To chassis ground.

* Set the 1,250 volt supply before setting the 325 volt supply (where the TSA-W is used with the STU-2W and STU-3W, STU-4W or STU-5W). When making the adjustment the appropriate rf unit must be installed.

5-6. BLANKING WIDTH ADJUST R2553.

Remove plug P2513 from input jack J2513 on the video chassis. Apply a sine wave signal through a capacitor to J2513. Set the SWEEP SPEED control to minimum (maximum counterclockwise) and adjust R2553, if necessary, until the retrace disappears. Recheck at 30 cycles and 1 cycle sweep.

5-7. PREAMPLIFIER ALIGNMENT.

It is recommended that a sweep signal generator, capable of sweep widths up to 100 mc centered at 160 mc, be used. It is also recommended that a 50 ohm 6 db pad be connected to J2801 to minimize undesirable effects due to cable length.

A cathode-ray oscilloscope having a sensitivity of 0.02 volt per inch or better should be used. Proceed as follows for correct alignment of the preamplifier.

- Apply the signal, through a 6 db pad, to connector J2801 on the preamplifier chassis.
- Construct a crystal detector circuit, as shown

in figure 4, and connect it at pin 1 or pin 8 of V2303.

c. Adjust L2803 and L2806 to obtain the response shown in figure 5.

d. Place a 100 ohm resistor across the output of the preamplifier at connector J2802.

e. Connect the detector circuit at the output and adjust L2808 for an overall response as shown in figure 6.

5-8. WIDE BAND AMPLIFIER ALIGNMENT.

The equipment needed is of the same type as required for preamplifier alignment. (See paragraph 5-7.) Proceed as follows:

a. Disable the sweep oscillator by removing V2509 from video chassis.

b. Apply the signal to J1301 through a 70 ohm 6 db pad connected directly to J1301.

c. Connect the crystal detector to either pin 3 or pin 6 of V1302 and adjust L1303 and L1306 to obtain the response shown in figure 7.

d. Remove the detector circuitry and connect the cathode ray oscilloscope to TP1301.

e. Adjust L1309 to obtain an overall response as shown in figure 8.

f. Connect the output of the preamplifier (at J2802) to the input of the wide band amplifier (J1301). (Use the cables and jumper provided for this purpose; W2551, W2552 and W2550, respectively.)

g. Readjust L2808 and L1301 to obtain the response shown in figure 9.

h. Remove cable from TP1301. Replace V2509 in video chassis. Set up the screen of the TSA-W as follows:

1. Sweep speed pot at 6.
2. Dispersion set for 70 mc.
3. Apply the signal through a 6 db pad to connector on pre-amp.

i. Center the sweeper generator for 160 mc. Set sweep width for 70 mc and amplitude for 5 divisions, baseline to peak. Repeak the following coils if necessary to obtain a flat response: L1309, L1306, L1303, L1301, L2803, L2808, L2806.

The response of the combined pre-amp and wide-band should not fall off more than 1 cm out of 5.

5-9. SWEEP OSCILLATOR ALIGNMENT.

a. Set the DISPERSION switch to HIGH, the DISPERSION control to 8, the CENTER FREQUENCY control to 7, and the SWEEP SPEED control to less than 20 cps.

b. Pull out V2504 and V2505 in the video chassis.

c. Apply a 110-mc signal, sine-wave modulated by a 400-cps audio signal to J1301. The percentage modulation level should be 30%.

d. Adjust L1314 for largest signal on screen.

e. Restore V2504 and V2505 to their respective sockets.

f. Introduce three signals, at frequencies of 125 mc, 160 mc and 195 mc, to the input of the wide band amplifier (J1301).

g. Adjust R2595, the Sweep Freq Linearity control; and R2534, the DISP. BAL. control until the signals are symmetrically spaced, setting the total dispersion to 70 mc.

h. Retune the 125 mc and 195 mc signals from generator to 156 mc and 164 mc, respectively.

i. Set the DISPERSION switch to LOW, leaving other settings the same.

j. Adjust L1316 and R2533 (located on the video

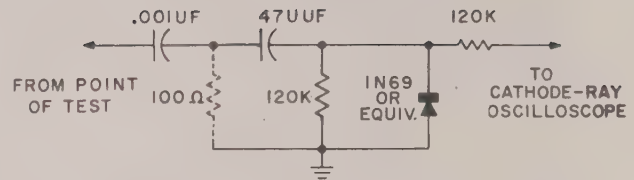


Figure 4. Crystal Detector

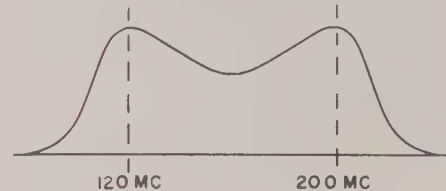


Figure 5. L2804 and L2806 Response Curve

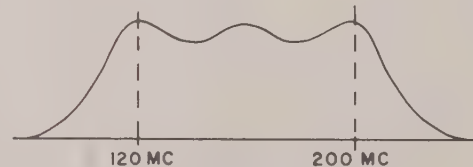


Figure 6. L2808 Response Curve

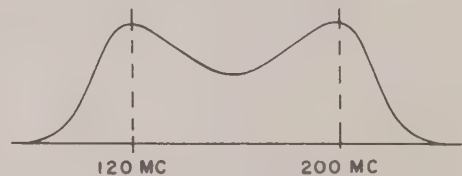


Figure 7. L1303 and L1306 Response Curve

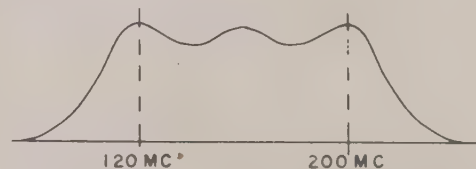


Figure 8. L1309 Response Curve

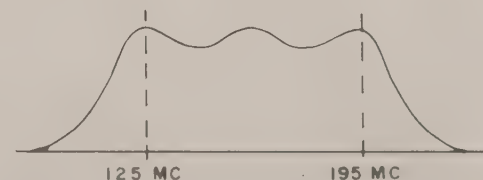


Figure 9. L2808 and L1301 Response Curve

chassis) for symmetrical signal spacing with the 160 mc pip in the center of the screen.

5-10. NARROW BAND CHASSIS ALIGNMENT.

a. Alignment of the narrow band chassis follows:

(1) Connect a 64 mc signal source, 30% modulated at a frequency of 400 cps to jack J2303 (located on the narrow band chassis), the input to the narrow band amplifier. Switch to LOW DISPERSION range.

(2) Apply sufficient output from the source to display a signal.

(3) Vary the tuning slugs located on the narrow band chassis, in the following sequence, until the displayed signal reaches maximum amplitude: 1st - T2301, L2301, L2311, T2303 top and bottom, L2311, L2308, L2312, T2302 top and bottom and L2306.

(4) For best results, repeat the entire alignment procedure at least once.

5-11. AMPLIFIER ADJUSTMENT (OVERALL).

a. Connect the preamplifier to the wide band amplifier, it in turn to the narrow band amplifier, and its output to the video amplifier.

b. Set VERT. GAIN control to maximum and adjust L1311 and L1315 in the wide band amplifier, as well as T2301 in the narrow band amplifier, for maximum noise display. I-f response should be ± 3 db at a sweep rate of less than 20 cps.

5-12. 500KC TRAP ADJUSTMENT.

a. Reduce the vertical gain to render noise imperceptible and switch to HIGH DISPERSION.

b. Apply a signal to J2303 and tune it about 64 mc for maximum deflection on the CRT.

c. A widening of the trace due to the 500 kc signal will be noted. Adjust C2501 using an insulated screw-driver for minimum trace width.

5-13. LOGARITHMIC AMPLIFIER ADJUSTMENT.

a. Without any signal applied and the VERT. GAIN control set to minimum, adjust R2571 for zero voltage at pin 3 of V2511.

b. Adjust R2590 for zero voltage at the logarithmic output connector, J130.

5-14. MARKER ZERO SETTING.

With the FREQUENCY DIFFERENCE MC control set to "0" and a 160 mc signal of known accuracy applied to J1301, two signals should zero beat. If they do not, adjust L2403 (on the marker chassis) for zero beat.

5-15. KLYSTRON TUBE REPLACEMENT.

The klystron tube is partially seated within the oscillator cavity which is assembled on the casting directly to the rear of the rf unit front panel. Replacement procedure follows:

a. Remove the Klystron Tube.

(1) BE SURE TO TURN OPERATING POWER OFF. Remove the rf tuning unit from the main chassis.

(2) Remove the breeze clamp holding the klystron protective cover to the klystron retainer nut and slide the cover back along the socket lead cable.

(3) Gently pull the tube socket assembly away from the base of the klystron tube.

(4) Use the spanner wrench supplied with the equipment to loosen the knurled collar at the end of the cavity. DO NOT REMOVE THE COLLAR COMPLETELY.

(5) Grasp the projecting end of the klystron tube, gently rotating it in a clockwise direction while simultaneously withdrawing the tube from its spring finger holders within the cavity.

b. Insert Replacement Klystron.

(1) Insert the tube carefully within the center of the cavity, and press it all the way in, rotating clockwise against a noticeable resistance as the internal contact ring-fingers make engagement, until it meets a positive stop*.

(2) Then retighten the large knurled collar, using the spanner wrench.

(3) Connect the socket to the base of the klystron tube. Use care to avoid breaking or bending the tube pins as the socket can be forced on in the wrong position. (As shown in figure 10, pin No. 1 is the pin apart from the other three.)

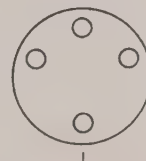


Figure 10. Klystron Tube-Pin Guide

* In the Models STU-3W, STU-4W, and STU-5W, there will be two clicks before the tube meets the stop.

(4) Replace the klystron protective cover by clamping it in place with the breeze clamp.

(5) Rotate the Anode Current screwdriver control to its extreme counterclockwise position.

5-16. REFLECTOR VOLTAGE TRACKING ADJUSTMENTS. (STU-2W, STU-3W, STU-4W, AND STU-5W.)

a. The reflector voltage tracking procedure which follows assumes that the unit was previously aligned and operating but that the klystron was changed. To set the reflector tracking voltages a modulator, a phase shift circuit, a voltmeter and a high gain oscilloscope are required. The preliminary set-up follows:

(1) Check the power supply reflector voltage** at pin 8 of J124, located at the rear of the main chassis, Model DU-W. Check the cathode voltage*** at pin 7 of J124. Readjust if necessary.

(2) With the power off, make the following connections:

nections:

(a) Connect the modulator to the reflector test jacks.

(b) Connect the phase shifting circuit to the external horizontal sweep input of the oscilloscope.

(c) Connect the output of the crystal mixer to the vertical input of the oscilloscope. The output is available at the 160 mc output jack.

(d) For STU-2W: Connect the negative terminal of a dc voltmeter to pin 1 and the positive terminal to pin 2 of R801, the Anode Current Adj. potentiometer. For STU-3W: Connect the positive lead of a dc voltmeter to pin 4 of jack J124 and the negative lead to chassis ground.

(3) Refer to table VI to set the reflector tracking voltages.

** -925 volts for STU-2W; -1850 volts for STU-3W through STU-5W.

*** -325 volts for STU-2W; -1250 volts for STU-3W through STU-5W.

TABLE VI. SETTING THE REFLECTOR TRACKING VOLTAGES

Step	Adjustment	Adjustment Location	Normal Indication
1	Set POWER ON-OFF switch to ON position. Wait approximately 1-minute for the delay relay to complete its cycle.	Front panel.	a. POWER indicator lights. b. After the one-minute delay period the KLYSTRON indicator lights.
2	Adjust the Anode Current Adj. potentiometer clockwise.	Reflector control board on rear of oscillator housing.	Dc voltmeter reads 10 volts between pins 1 and 3 of V801 (STU-2W); 3.2 volts between pin 4 of J124 and gnd for STU-3W, STU-4W, and STU-5W.
3	Rotate TUNING knob to set frequency dial to high end.	Tuning unit front panel.	Calibration mark* appears under the index hairline.
4	Adjust the Modulation Amplitude and phase shift controls.	Modulator Unit (fig. 12).	A single mode pattern appears on the screen.
5	Adjust the High-Limit screwdriver control.	Reflector control board on rear of oscillator housing.	The mode moves to the center of the screen.
6	Rotate TUNING knob to set frequency dial to low end.	Tuning unit front panel.	Calibration mark** appears under the index hairline.
7	Increase the Modulation Amplitude and adjust the Phase Shift control.	Modulator Unit.	A single mode pattern appears on the screen.
8	Adjust the Low-Limit screwdriver control.	Reflector control board on rear of oscillator housing.	The mode moves to the center of the screen.

TABLE VI. SETTING THE REFLECTOR TRACKING VOLTAGES (Continued)

Step	Adjustment	Adjustment Location	Normal Indication
9	Rotate TUNING knob to high frequency side of mode switch, just after it clicks.	Tuning unit front panel.	Dial is set at about -1,250 mc for STU-2W. -7,800 mc for STU-3W. -23,240 mc for STU-4W.
10	Adjust the Modulation Amplitude and Phase Shift controls.	Modulator Unit.	A single mode pattern appears on the screen.
11	Adjust the screwdriver control marked High-Mode for Models STU-2W, STU-3W, STU-4W.	Reflector control board on rear of oscillator housing.	The mode moves to the center of the screen.
12	Rotate the TUNING knob to the low frequency side of the mode switch just after it clicks.	Tuning unit front panel.	Dial is set at approximately -1,250 mc for STU-2W, -7,800 mc for STU-3W, -23,240 mc for STU-4W.
13	Adjust the Modulation Amplitude and Phase Shift controls.	Modulator Unit.	A single mode pattern appears on the screen.
14	Adjust screwdriver control marked Low-Mode for Models STU-2W, STU-3W, STU-4W.	Reflector control board on rear of oscillator housing.	The mode pattern moves to the center of the screen.
15	Repeat steps 3 through 14 until no further adjustment is required.		The modes remain centered without further adjustment as the steps are repeated.

* 2,200 mc (on low range) for STU-2W; 10,920 mc (on low range) for STU-3W; 33,000 mc for STU-4W; 44,000 mc for STU-5W.

** 910 mc for STU-2W; 4,370 mc for STU-3W; 21,000 mc for STU-4W; 33,000 mc for STU-5W.

5-17. FREQUENCY IN MEGACYCLES DIAL ADJUSTMENT.

a. For Models STU-2W, STU-3W, STU-4W and STU-5W, proceed as directed in table VII. The dial adjustment which follows assumes that the unit was previously aligned and operating but that the klystron was changed. To calibrate the FREQUENCY IN MEGACYCLES dial, the following equipment is required.

(1) A signal generator covering the required range.

(2) A high gain oscilloscope

b. For Model STU-1W the dial frequency calibration which follows assumes that the unit was previously aligned and operating but that the local oscillator tube V601, was changed. A signal generator at the frequencies 10 and 400 mc is required. Proceed as follows:

(1) Withdraw the Model STU-1W from the main chassis (paragraph 5-2).

(2) Set up the spectrum analyzer for operation

(paragraph 3-2). The input signal should be a 400 mc signal of known accuracy.

(3) Rotate the TUNING knob to set the frequency dial at the high frequency side. Tune in the signal so that it coincides with the marker pip at the center of the display screen (frequency dial at approximately 400 mc).

(4) Loosen the two set screws holding the frequency dial hub to its shaft. Turn the dial on the shaft until the 400 mc mark is at the hairline. Hold the dial fixed in position and tighten one of the set screws. Then tighten the other set screw.

(5) Set the Model STU-1W on its side so that the bottom is accessible. Set the frequency dial to 10 mc. Apply a 10 mc input signal of known accuracy.

(6) Remove the plug button covering the access hole to the tracking capacitor (the access hole is located on the bottom of the rf unit cover). Adjust the tracking capacitor until the input signal pip coincides with the marker signal pip at the center of the display. The FREQUENCY IN MEGACYCLES dial is now fully calibrated.

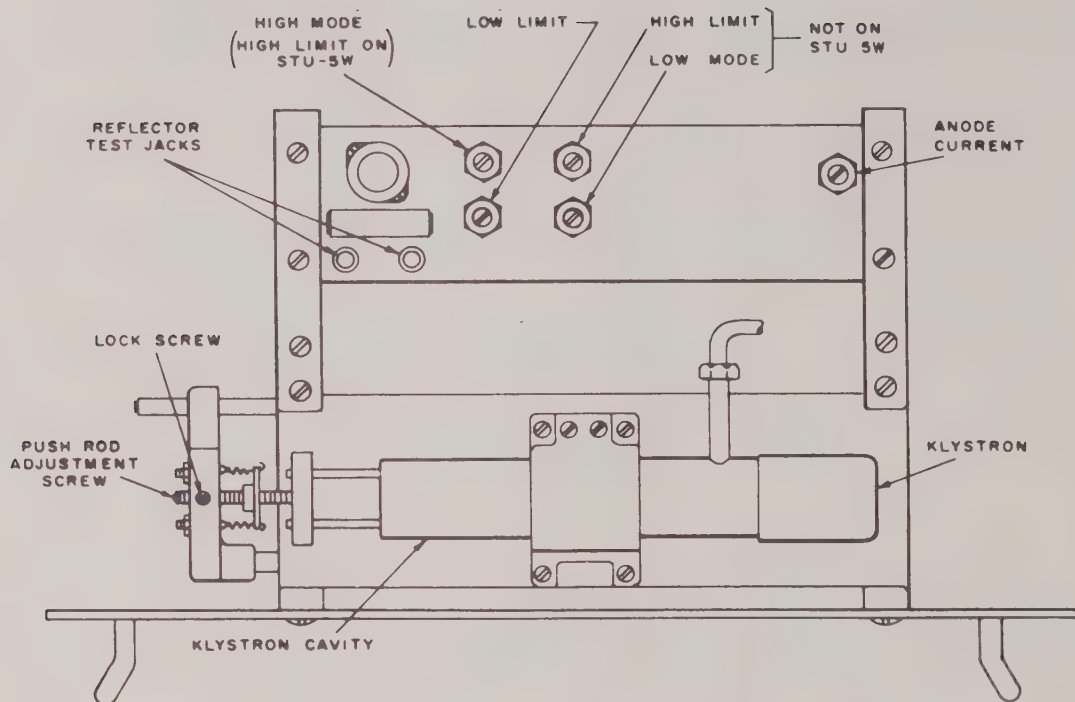


Figure 11. Top View of R-F Tuning Unit

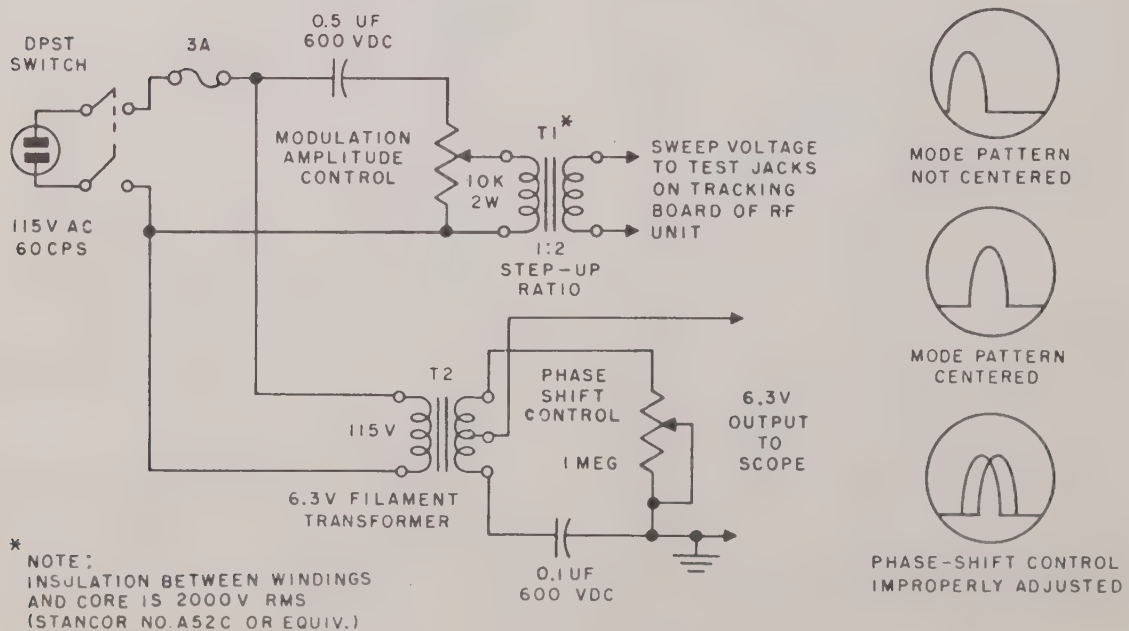


Figure 12. Modulator and Phase Shifting Circuits, Schematic Diagram

TABLE VII. TUNING DIAL ADJUSTMENT PROCEDURE

Step	Adjustment	Adjustment Location	Normal Indication
1	Connect the signal generator to the DIRECT R-F INPUT jack. Set POWER ON OFF switch to ON and wait 1 minute.	Front panel.	a. POWER indicator lights. b. After the 1-minute delay period, the KLYSTRON indicator lights.
2	Set MARKER switch to ON, MARKER AMPLITUDE to 2 inch deflection, FREQUENCY DIFFERENCE MC to zero and the DISPERSION control to 8.	Front panel.	The marker pip should appear at the center of the spectrum display screen. If not centered, adjust to center with the CENTER FREQUENCY control.
3	Rotate the TUNING knob to the high frequency end of the tuning dial and tune the signal generator tuning dial to the same frequency.	Front panel and signal generator.	A second pip appears on the Spectrum Display Unit screen.
4	Tune the signal generator so that the pips coincide.	Signal generator.	Record signal generator frequency (actual frequency) as against dial frequency.
5	Repeat steps 3 and 4 for all frequencies indicated on the low scale of the tuning dial.	Front panel and signal generator.	The true frequency should be within 1% of the dial frequency at all points. If not, proceed to step 6.
6	Set the dial reading and the wave-meter*.	Signal source front panel and wavemeter knob.	Pip appears on mode.
7	Loosen the No. 6 setscrew which locks the top push rod adjustment screw (figure 11).	Oscillator push plate.	Pip should remain on the mode.
8	Adjust the push rod adjustment screw to center the mode.	On oscillator push plate.	The pip should be centered.
9	Lock the push rod adjustment screw in place by tightening the No. 6 setscrew.	On oscillator push plate.	The pip should remain centered on the mode.
10	Repeat steps 1 to 5 above and the reflector tracking procedure.		Tuning unit should be accurately calibrated

* STU-2W - 1,600 mc; STU-3W - 8,000 mc; STU-4W - 27,500 mc; STU-5W - 39,000 mc. Calibrating the dial at these frequencies will normally set both the high and low frequency extremes within $\pm 1\%$. With some klystrons, however, it may be necessary to compensate. For example, the dial might be set to slightly below 8,000 mc, for the STU-3W, to compensate for an out of tolerance ($+1\%$) reading at one extreme. Care must be taken that the other extreme is not set out of tolerance and step 5 should be repeated as a check.

5-18. MINIMUM DISCERNIBLE SIGNAL SENSITIVITY.

To check the overall sensitivity of the TSA-W proceed as outlined: Turn the DISPERSION control CCW until it is a minimum. Set the DISPERSION switch (ganged to the DISPERSION control) to the LOW DISPERSION position. Place the COARSE and VERNIER FREQUENCY DIFFERENCE controls at zero and using the CENTER FREQUENCY control center the marker on the CRT screen. Adjust the VERTICAL GAIN con-

trol until the noise amplitude displayed on the CRT screen is approximately $1/4$ inch. Connect the output of a signal generator into DIRECT RF INPUT of the STU Tuning Unit, and set the signal generator at the desired frequency. Using the attenuator control on the signal generator, adjust the amplitude of the output signal until it is barely visible above the noise viewed on the CRT screen. Record the reading of the signal generator attenuator control. This is the sensitivity of the TSA-W.

5-19. WIDE BANDPASS FILTER ALIGNMENT.

To align the wide bandpass filter, proceed as follows:

- a. Connect the output of a signal generator to the DIRECT R-F INPUT connector on the front panel.
- b. Turn the POWER switch to ON and allow a 30-minute warmup period.
- c. Tune the signal generator to 160 mc.
- d. Tune L604 for maximum output, as observed on the display screen.
- e. Set the signal generator frequency to 147.5 mc.
- f. Tune C603 and then C605 for maximum output. Note which capacitor has the smaller effect.
- g. Set the signal generator frequency to 172.5 mc and tune that capacitor, which had the smaller effect in the previous step, for maximum output.
- h. As there will be interaction between the tuning elements, it will be necessary to repeat the adjustment of L604, C603 and C605 until maximum output is obtained without further adjustment.

5-20. 160 MC NARROW BANDPASS FILTER ALIGNMENT.

To align the narrow bandpass filter, turn the TUNING control to obtain a frequency below 55 mc. Then proceed as follows:

- a. Connect the output of a signal generator to the DIRECT R-F INPUT connector on the front panel.
- b. Turn the POWER ON-OFF switch to ON and allow a 30-minute warmup period.
- c. Tune the signal generator to 160 mc.
- d. Tune L612 for maximum output, as observed on

the display screen.

- e. Set the signal generator frequency to 157.5 mc.
- f. Tune C617 and then C619 for maximum output. Note which capacitor has the smaller effect.
- g. Set the signal generator frequency to 162.5 mc and tune that capacitor which had the smaller effect in the previous step, for maximum output.
- h. As there will be interaction between the tuning elements, it will be necessary to repeat the adjustment of L612, C617, and C619 until maximum output is obtained without further adjustment.

5-21. LOW-PASS FILTER ALIGNMENT.

With no signal at the input of the rf unit, turn to 16 mc on the tuning dial. A spurious signal appears at this frequency. Tune L631 and L632 to reduce the spurious signal to a minimum.

5-22. MIXER MATCHING NETWORK ADJUSTMENT.

a. Apply a signal to the rf tuning unit and adjust the tuning control so that the signal appears in the center of the screen with the CENTER FREQUENCY control set in the middle of its range and the dispersion adjusted to 70 mc.

b. Adjust tuning capacitor C1501 for maximum pip height.

c. Move the signal across the screen and note variation in the height. If it exceeds 3 db, readjust the tuning capacitor until a reasonably uniform response is obtained. The sweep rate should be below 20 cycles per second.

VOLTAGE AND RESISTANCE CHART TSA-W MODEL DU-W CHASSIS

Tube		Pin Numbers						
		1	2	3	4	5	6	7
XV101 /	V R		530 ∞		-235 ∞		-235 ∞	
XV101 #	V R		680 ∞		-650 ∞		-650 ∞	
XV102 /	V R		-220 ∞		-700 170K		-700 170K	
XV102 #	V R		-560 ∞		-1800 170K		-1800 170K	
XV103 /	V R		125 25K	-7.8* 150K	3.2 100			
XV103 #	V R		125 25K	-8.4* 150K	3.2 100			
XV104 /	V R		125 25K	-7.8* 150K	3.2 125			
XV104 #	V R		125 25K	-8.4* 150K	3.2 125			
XV105 /	V R	-7.8* 150K	-80* 68K	-79 30K			-80* 68K	-153 500K
XV105 #	V R	-8.4* 150K	-82* 68K	-80 30K			-82* 68K	-153 500K
XV107 /	V R	-325				-325		
XV107 #	V R	-1250				-1250		
XV110 /	V R							-92 170K
XV110 #	V R							-18 90K
XV111	V R		420 ∞		265AC 25		265AC 25	
XV112	V R	480 30K		260AC 25	260AC 25		480 30K	260 25
XV113	V R	0 0	-150 20K		-150 20K	0 0		-150 20K
XV114	V R	115 500K	165 ∞	125 32K	110 500K	165 ∞	125 20K	
XV115	V R	-4* 100K	0 0			110 500K	125 20K	0 0
XV116	V R		420 ∞		240AC 25		240AC 25	
XV117	V R	275* ∞	390 ∞	300 30K	275* ∞	390 ∞	300 30K	
XV118	V R	-1.5* 100K	0 0			275 ∞	24 68K	0 0
XV120	V R	3 100		280 30K		150 57K		100K

NOTES: 1. All measurements were taken with controls and switches set as follows:

- DISPERSION switch (S2501) at HIGH
 - DISPERSION control (R2524) at maximum clockwise position
 - VERT GAIN (R2511B) at maximum clockwise position
 - SWEEP SPEED control (R2560) at maximum clockwise position
 - LOG-LIN switch (S2505) at LIN
 - CENTER FREQ control (R2530) at center position
 - HOR POS, VERT POS and HOR GAIN controls normal
 - MARKER ON-OFF switch to ON
 - Marker oscillator set to zero difference
- / - STU-2
 - # - STU-3, 4, 5
 - * - Measurement taken with VTVM
 - All voltages are DC and measured from pin to ground unless otherwise indicated
 - All waveform voltage measurements are peak-to-peak

8		9		CAP
530	∞			
680	∞			
-560	∞			
				415 ∞
				680 ∞
				415 ∞
				680 ∞
-150	45K			
-150	45K			
420	∞			
420	∞			

23/24

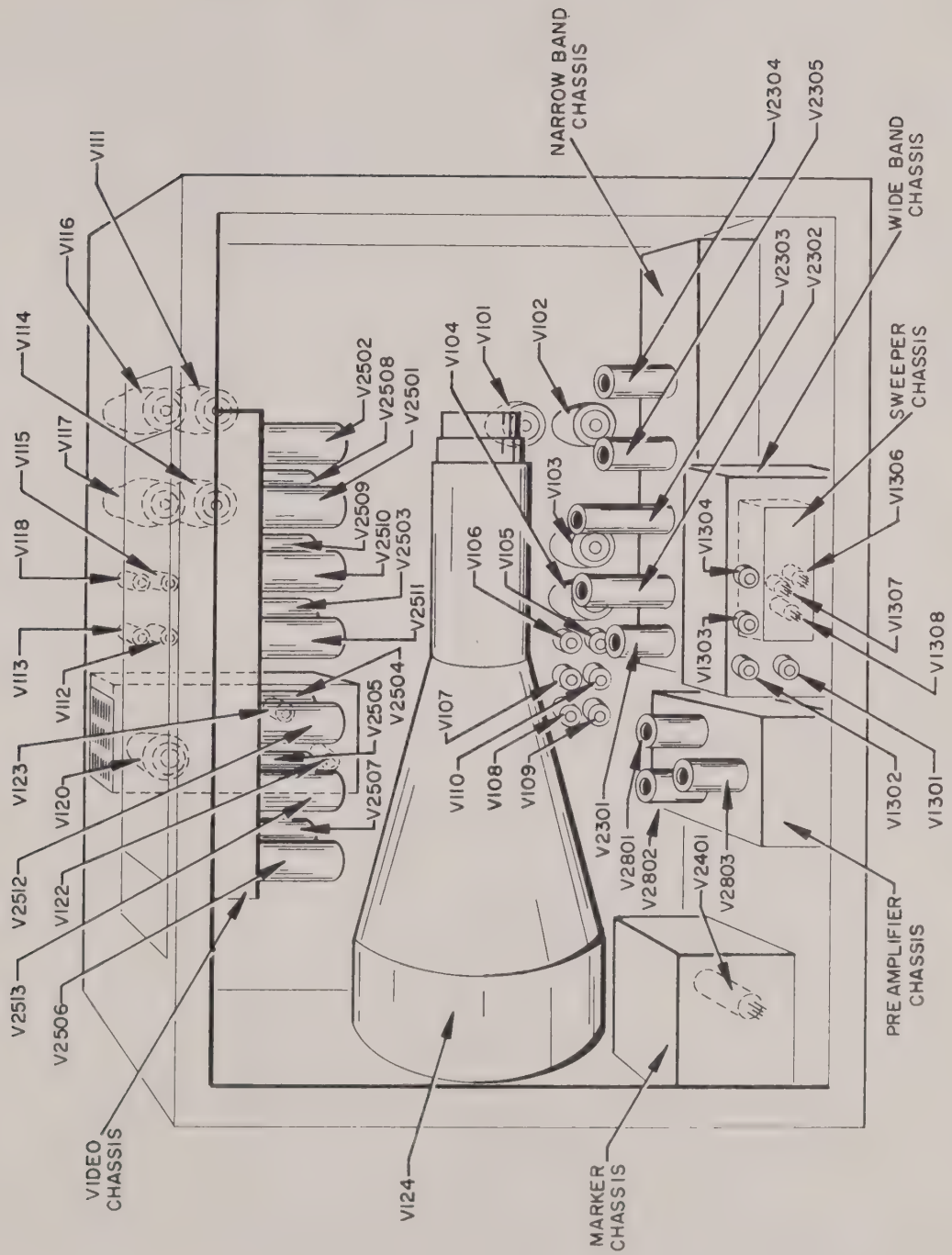
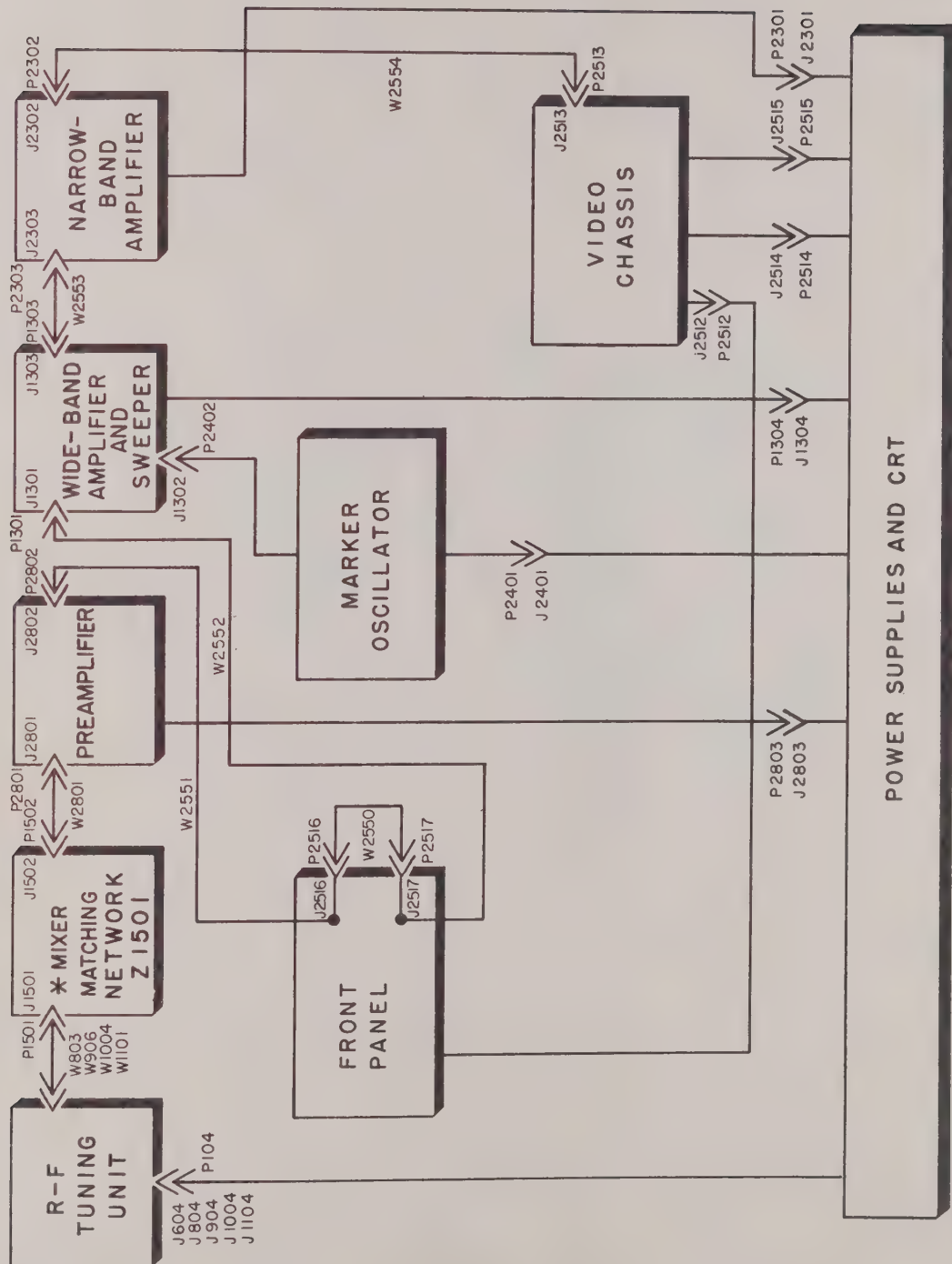
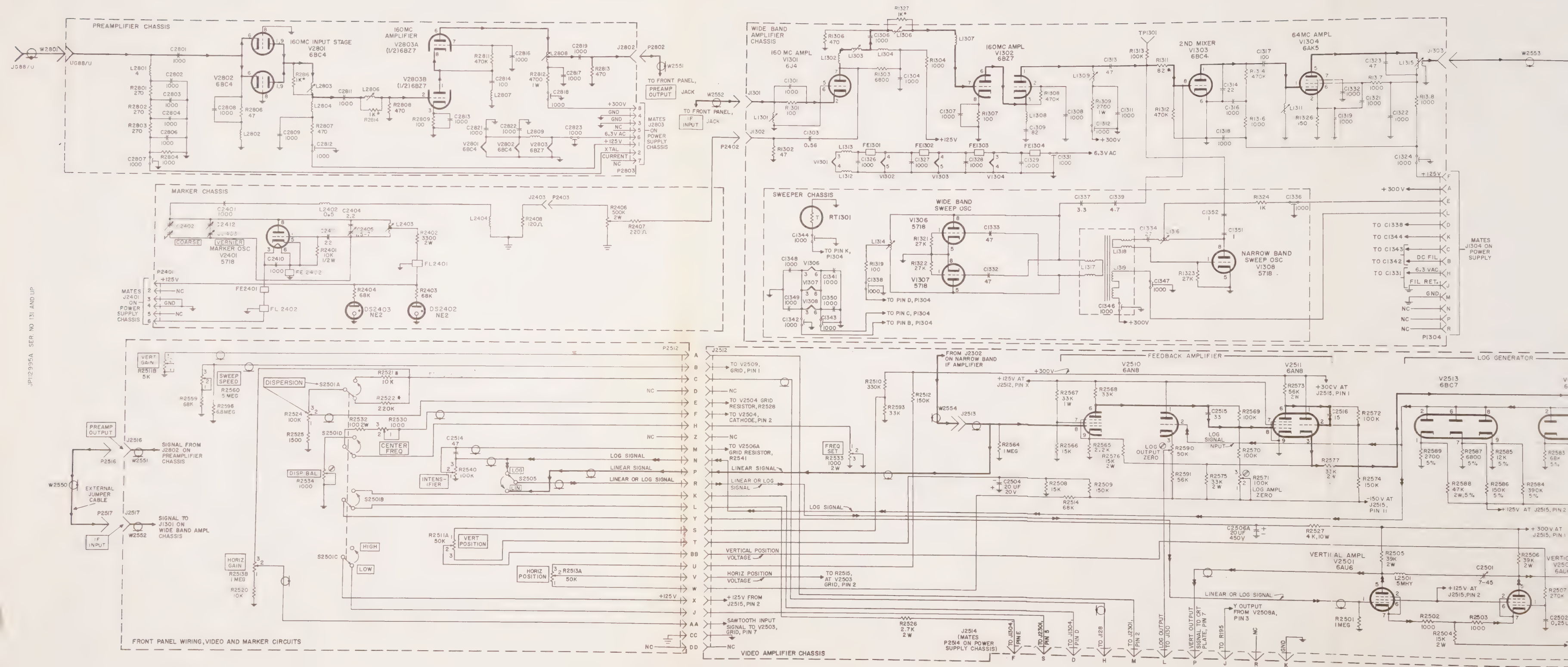
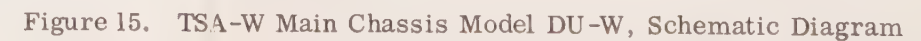


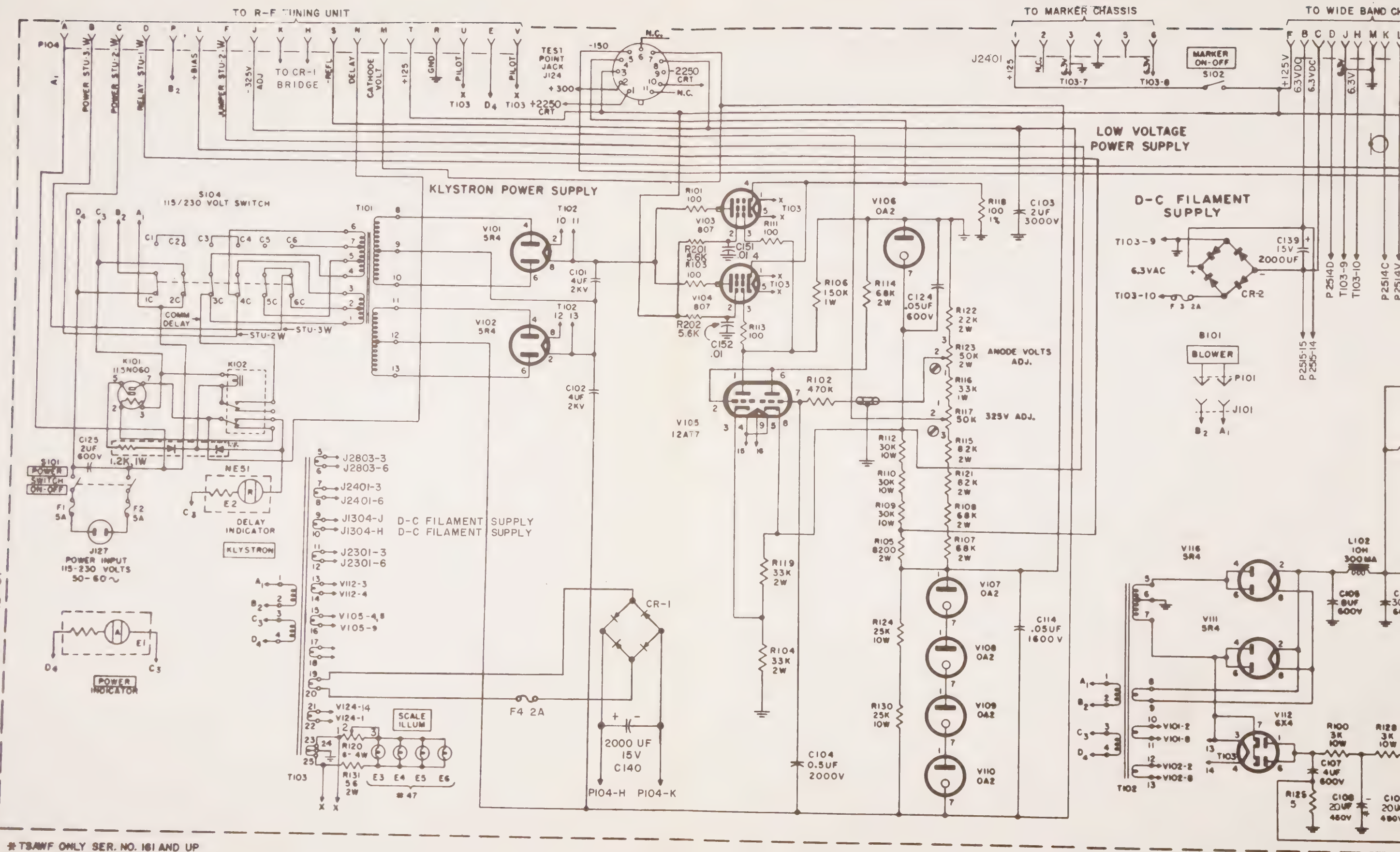
Figure 13. Location of Subchassis and Tubes



JPI2995A SER. NO. 131 AND UP







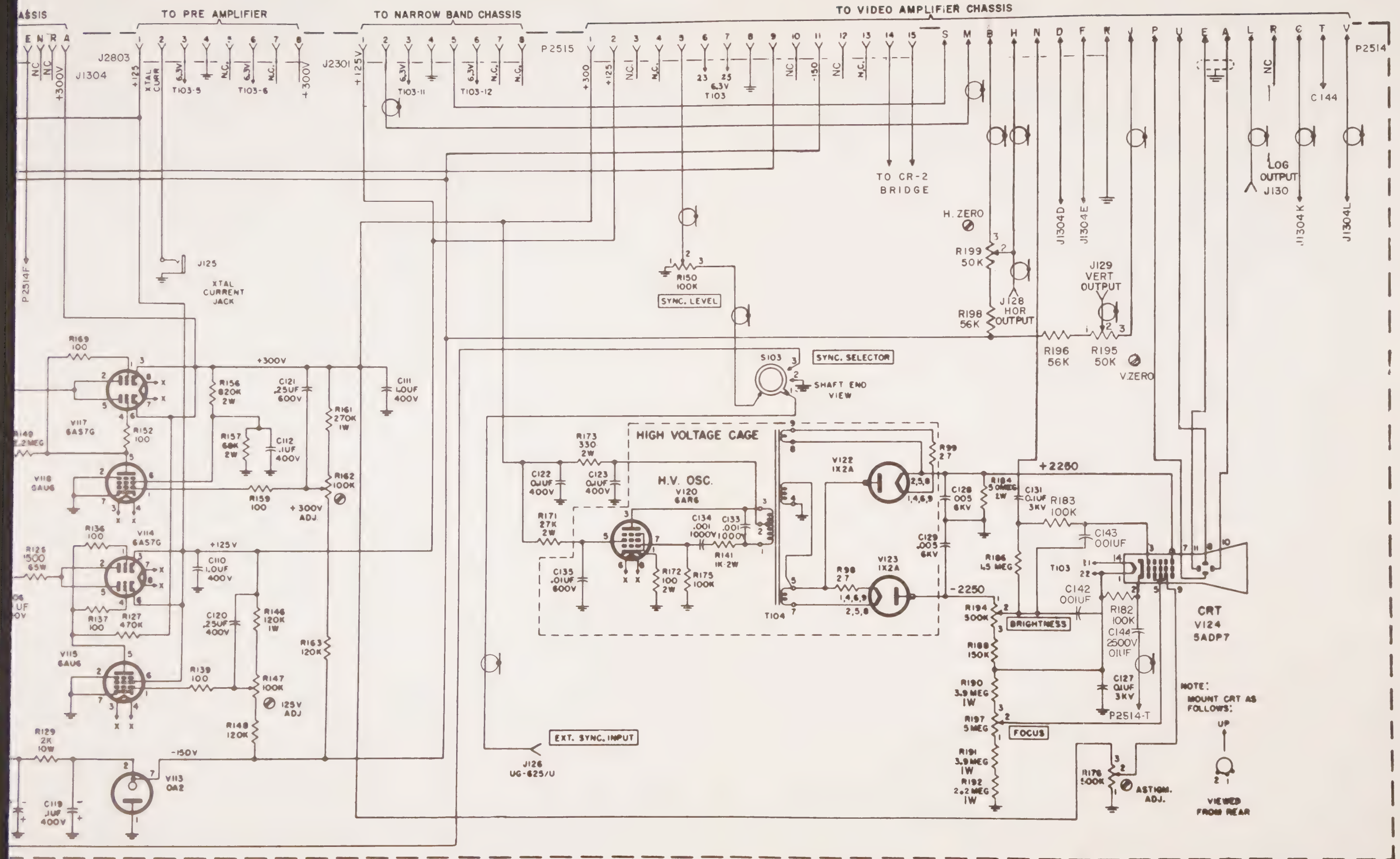


Figure 16. TSA-W Subchassis and Video Circuits, Schematic Diagram

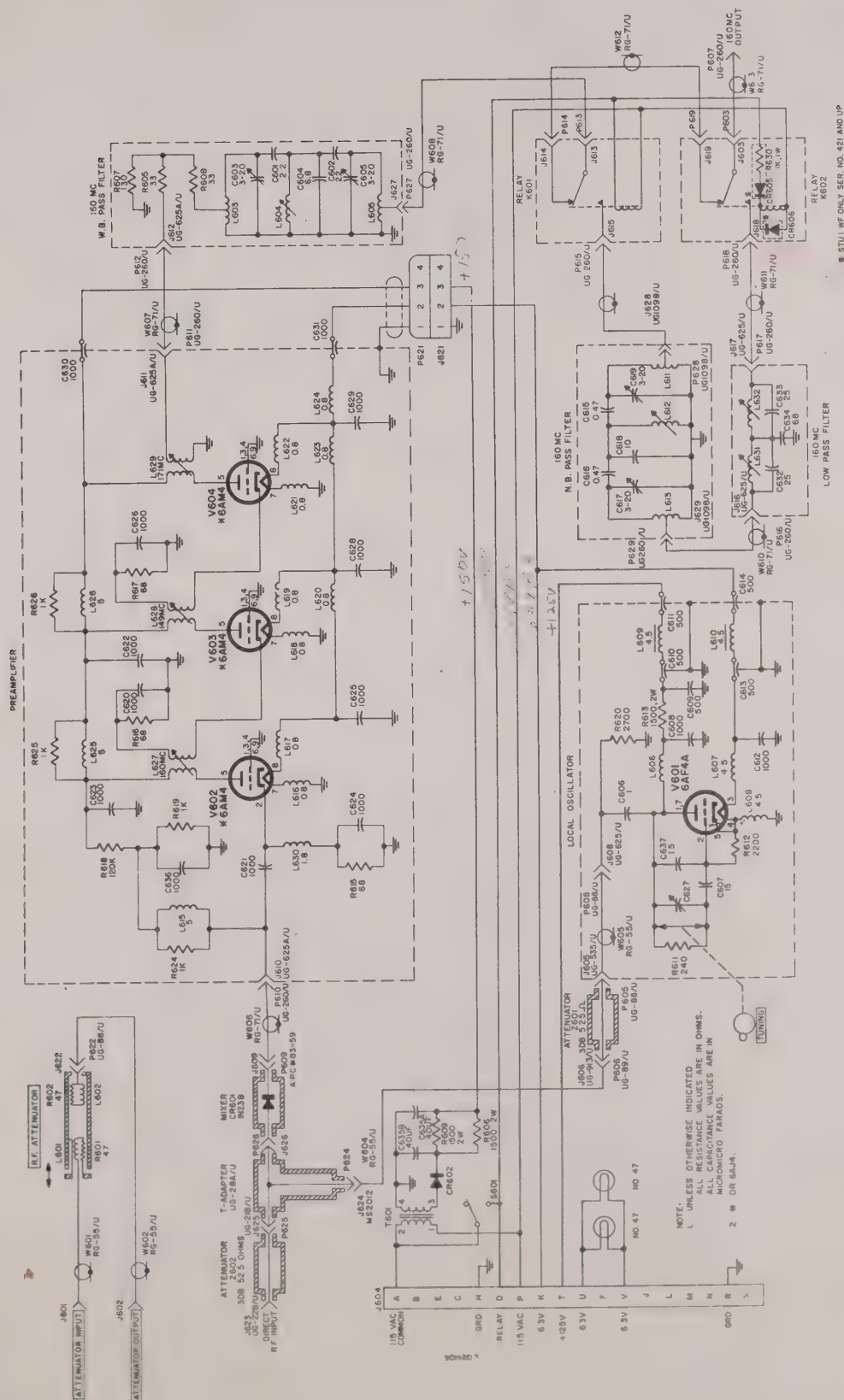


Figure 17. R-F Tuning Unit Model STU-1W (10 mc to 1000 mc)

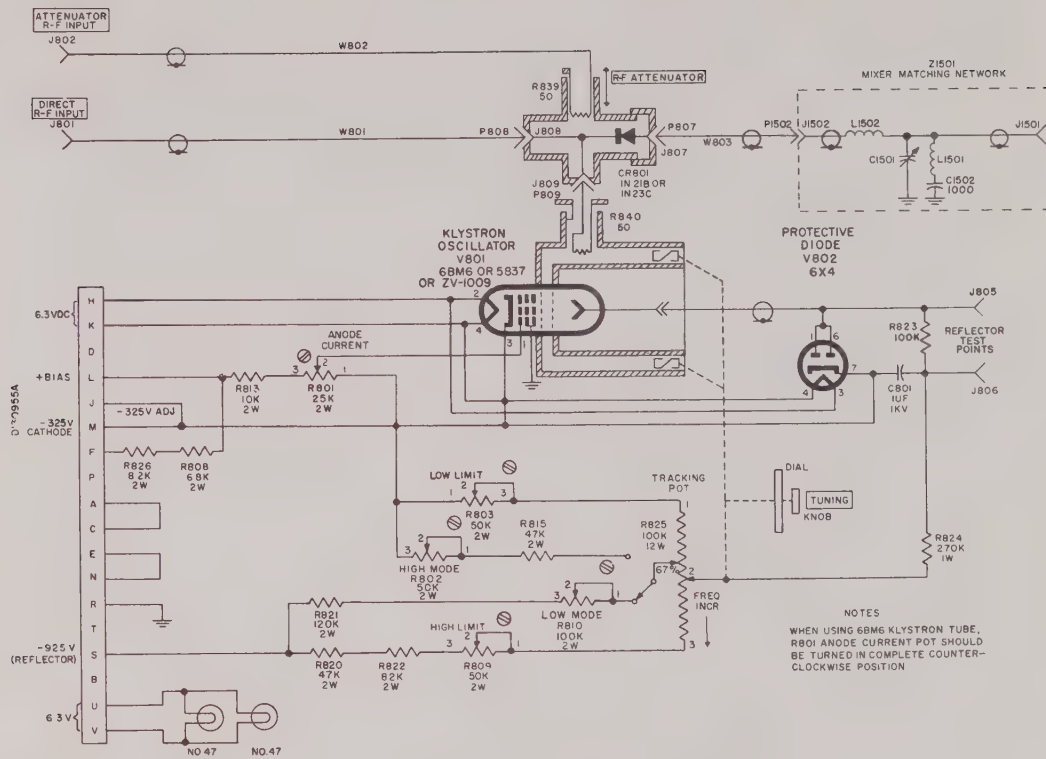


Figure 18. R-F Tuning Unit Model STU-2W (910 mc to 4560 mc)

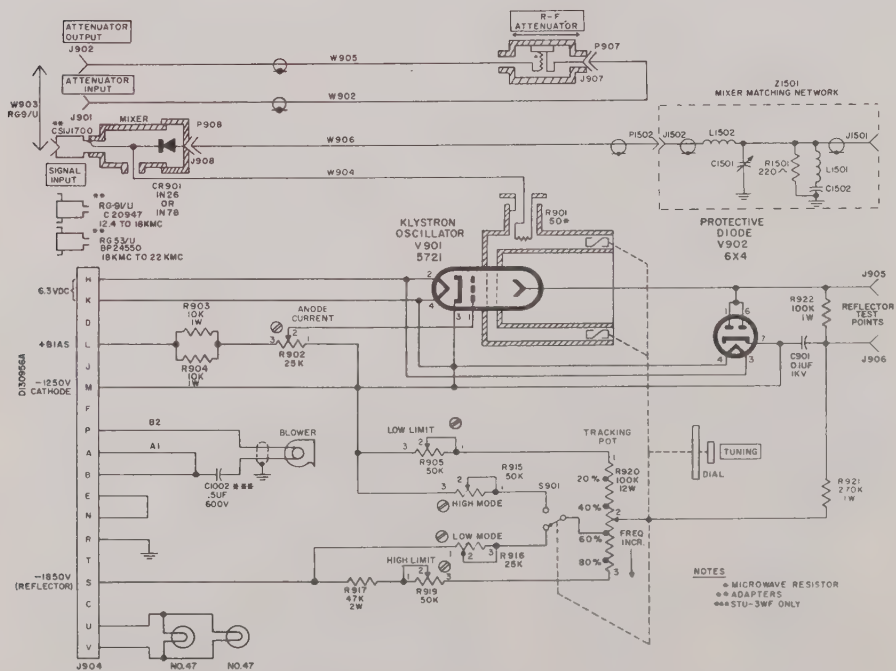


Figure 19. R-F Tuning Unit Model STU-3W (4370 to 22000 mc)

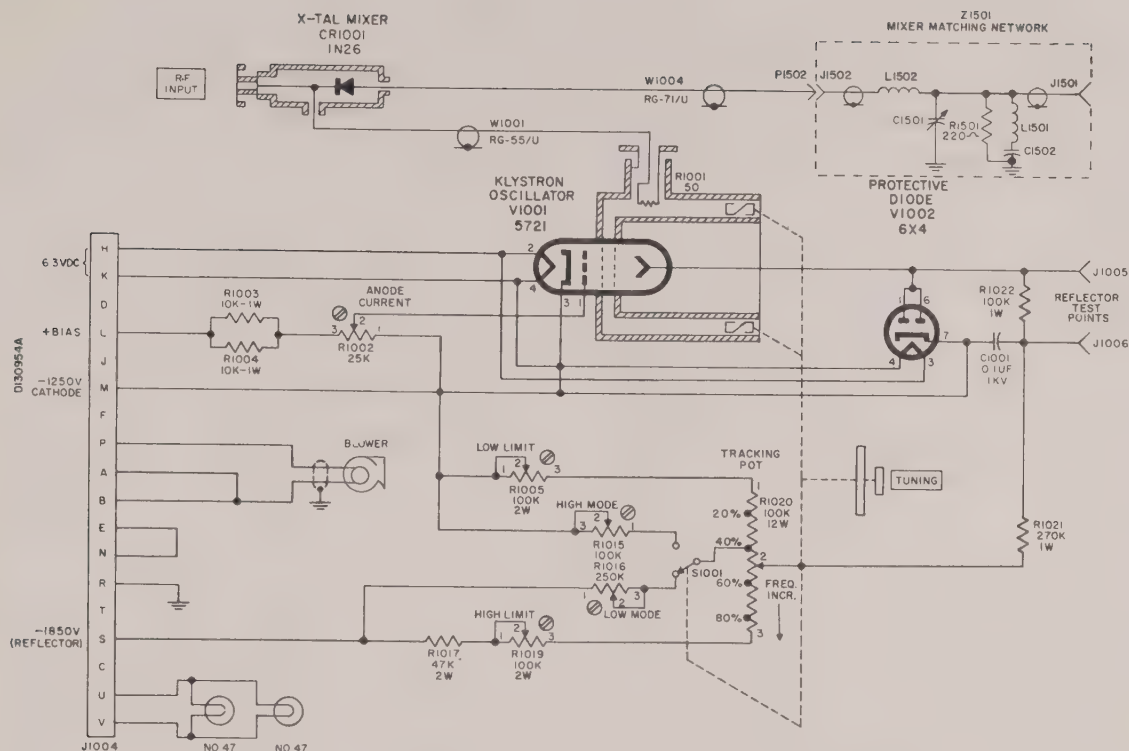


Figure 20. R-F Tuning Unit Model STU-4W (21000 to 33000 mc)

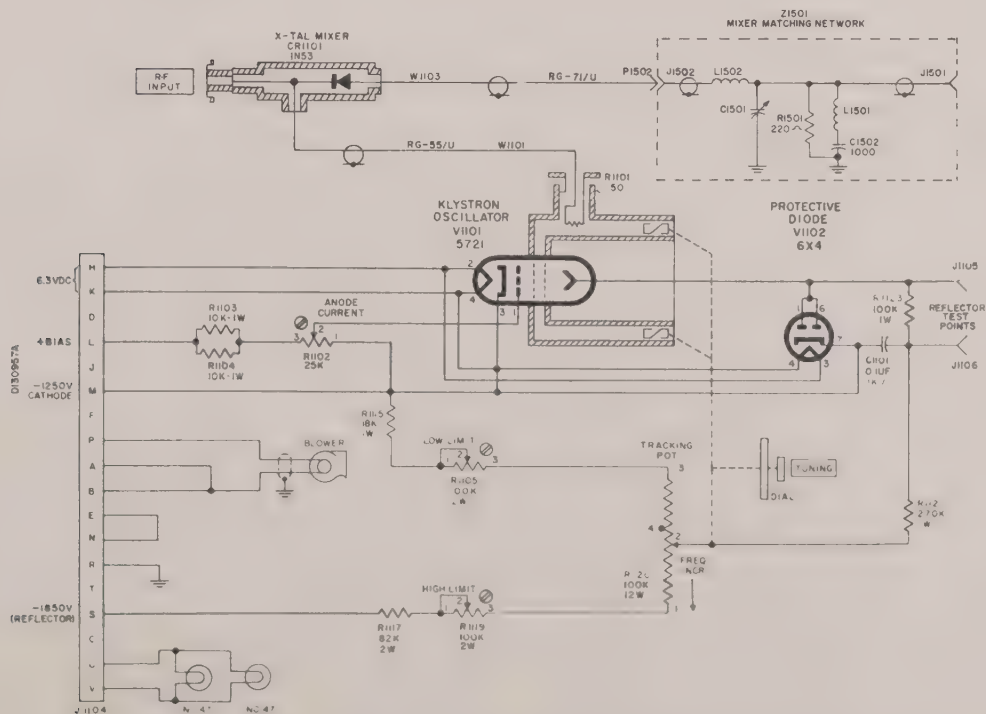


Figure 21. R-F Tuning Unit Model STU-5W (33000 mc to 44000 mc)

SECTION VI

SPARE PARTS LIST

6-1. SPARE PARTS.

The parts included below are electron tubes, crystals and non-standard parts used in this unit, and may be purchased from Polarad Electronics Corporation.

Reference Designation	Description	Polarad Part No.	Reference Designation	Description	Polarad Part No.
B101	Blower (STU-1W, 2W) Fan Blade for B101 Blower (STU-3W, 4W, 5W)	BP22146 BP21194-1 CP20756	L611	Coil, Fixed	A24106
C2402	Capacitor, Variable	A106573	L612	Coil, Variable	A107223
CR1, CR2	Rectifier, Germanium	A27794	L613	Coil, Fixed	A24107
CR601	Diode, Silicon	1N23B	L616,	Choke, 0.8 uh	AP21094
CR602	Rectifier, Selenium	A27661	L617,		
CR801	Diode, Silicon	1N21B or 1N23C	L618,		
CR901	Diode, Silicon	1N26 or 1N78	L619,		
CR1001	Diode, Silicon	1N26	L620,		
CR1101	Diode, Silicon	1N53	L621,		
CR2301,	Diode, Germanium	1N69	L622,		
CR2502			L623,		
CR2501	Diode, Germanium	1N198	L624	Choke, 5 uh	A100676
E1	Pilot Light Ass'y, Amber	2210-104	L625,		
E2	Pilot Light Ass'y, Red	2210-105	L626,		
F1, F2	Fuse, Slo Blo	5A-3AG	L2302,		
FE1301,	Bead Shield	All5516	L2303,		
FE1302,			L2304	Transformer, 160 mc	AP23974
FE1303,			L627	Transformer, 149 mc	AP23975
FE1304,			L628	Transformer, 171 mc	AP23976
FE2401			L629	Coil, 1.8 uh	A19770
K101	Relay, Thermal Delay	115N060	L630	Coil, Variable	A24176
K102	Relay, DPST	2210-107	L631,		
K601,	Relay,	AP22293	L632	Coil, Variable	All1446
K602			L1301	Choke	All1436
K2301	Relay, DPDT	All5514	L1302	Coil, Variable	All1447
L102	Choke, 10H, 300 ma	2210-109	L1303	Choke	All1438
L603	Choke	AP22711	L1304,		
L604	Coil, Variable	AP22372	L1308		
L605	Coil, Fixed	AP22371	L1306	Coil, Variable	All1445
L606	Coil, Fixed	A24132	L1307	Choke	All1437
L607,	Choke	All1441	L1309	Coil, Variable	All1448
L608, L609,			L1311	Coil, Variable, 64 mc	All1449
L610, L1312,			L1314	Coil, Variable	All1440
L1313, L2317,			L1315	Coil, Variable, 64 mc	All1450
L2318, L2319,			L1316	Coil, Variable	All1439
L2404, L2405,			L1317	Ferrite	All1294
L2809			L1318	Ferrite	All1293
			L1319	Reactor	B111355
			L1501	Coil, Fixed	All12720
			L2301	Coil, Variable, 64 mc	A100969
			L2306	Coil, Variable, 29 mc	A100822
			L2307	Choke, 50 uh	A101170
			L2308,	Coil, Variable, 500 kc	All1193
			L2312		

Reference Designation	Description	Polarad Part No.
L2309, L2314, L2316, L2321, L2322	Choke, 100 uh	A101169
L2311	Coil, Variable, 5.5 mc	A100970
L2313, L2501	Coil, Fixed, 5 mh, 125 ma	A115515
L2402	Coil, 0.5 uh	ASK13335
L2403	Coil, Variable	ASK13336
L2801	Choke, 4 uh	A110542
L2802	Coil, Fixed	A110543
L2803	Coil, Variable	A110544
L2804, L2807	Coil, Fixed	A110545
L2806	Coil, Variable	A110546
L2808	Coil, Variable	A110548
R184	Resistor, 50 Meg, 2W	RC42GF506K
R825, R1120	Potentiometer, Track- ing, 100K, 12W	BK5413
R839, R840, R901, R1001, R1101	Resistor, 50 ohm, Type R	A544104
R920, R1020	Potentiometer, Track- ing, 100K, 12W	CK5033
R2511A & R2511B	Potentiometer, Dual Concentric, 50K, 5K	AP20764
R2513A & R2513B	Potentiometer, Dual Concentric, 50K, 1 Meg	AP20765
R2524 w/ S2501	Potentiometer & Switch 100K ohms	C111709
RT1301	Thermistor	A106862
S101, S102	DPDT Switch	CH8373K8
S103	Switch, Rotary	2210-103
S104	Switch, Rotary	2210-104
S601	Switch	AP20438
S901, S1001	Micro-Switch	AK5412
S2501	See R2524	
S2505	Switch	A112732
T101	Transformer, Klystron Power Supply	BP22134
T102	Transformer, Power	BP22133
T103	Transformer, Filament	BP22132
T104	Transformer, High Voltage Supply	AP21385
T601	Transformer, Power	B23666
T2301	Transformer, I-F, 64 mc	A101007

Reference Designation	Description	Polarad Part No.
T2302	Transformer, I-F, 6 mc	B106482
T2303	Transformer, I-F, 500 kc	C111194
V101, V102, V111, V116, V103, V104	Tube, Electron	5R4
V105, V2508	Tube, Electron	807
V106, V107, V108, V109, V110, V113	Tube, Electron	12AT7
V112, V802, V902, V1002, V1102	Tube, Electron	0A2
V114, V117	Tube, Electron	6X4
V115, V118, V2501, V2502, V2505	Tube, Electron	6AS7G
V120, V122, V123	Tube, Electron	6AU6
V124	Cathode Ray Tube	6AR6
V601	Tube, Electron	1X2A
V602, V603, V604	Tube, Electron	5ADP7
V801	Tube, Klystron	6AF4A
V901, V1001, V1101	Tube, Klystron	6AJ4
V1301	Tube, Electron	6BM6 or 5837
V1302, V2803, V1303, V2801, V2802	Tube, Electron	5721
V1304, V2301	Tube, Electron	6J4
V1306, V1307, V1308, V2401	Tube, Electron	6BZ7
		6BC4
		6AK5
		5718

Reference Designation	Description	Polarad Part No.
V2302, V2303	Tube, Electron	6BA7
V2304, V2305	Tube, Electron	6AG5
V2503, V2507	Tube, Electron	12AU7
V2504	Tube, Electron	6AQ5
V2506, V2510, V2511	Tube, Electron	6AN8
V2509	Tube, Electron	6AS6
V2512, V2513	Tube, Electron	6BC7
Y2301	Crystal, CR-23/U, 29 mc	Al15513
Z601	Attenuator	AK5530
Z602	Attenuator	A26581
Z1501	Mixer Matching Net- work	B110529
—	Calibrated Scale	BP21124
—	CRT Bezel	DP20306
—	Filter, Amber	B27336-1
—	Filter, Blue	B27336-2
—	Filter, Air	CP20807
—	Klystron Spring Re- tainer for STU-2W;	AK5403
—	for STU-3W, 4W, 5W	AP17505

Reference Designation	Description	Polarad Part No.
—	Low Pass Filter Ass'y	BP24000
—	Marker Chassis Ass'y	D111658
—	N. B. Pass Filter Ass'y	BP21707
—	Narrow Band Chassis Ass'y	D111192
—	Preamplifier Chassis Ass'y	Cl10532
—	STU-1W Preamplifier Chassis Ass'y	CP23892
—	STU-1W Crystal Holder	AK5535
—	STU-1W Variable Attenuator	CP21383
—	STU-2W Mixer	CP22569
—	STU-2W Osc. Probe	BP22572
—	STU-2W Osc. Cavity	CP20566
—	STU-3W Mixer	DP24014
—	STU-3W Attenuator	CP23961
—	STU-3W, 4W, 5W Osc. Cavity	CP20512
—	STU-4W Mixer	CP21501
—	STU-5W Mixer	CP23206
—	Video Chassis Ass'y	D112730
—	W. B. Pass Filter Ass'y	BP22161
—	Wide Band-Sweeper Chassis Ass'y	B111296

POLARAD ELECTRONICS CORP.

CONSULTANTS — DESIGNERS — MANUFACTURERS

43-20 34th Street Long Island City 1, N. Y.

EXeter 2-4500

REQUEST FOR MAINTENANCE

FROM:

COMPANY NAME _____

DATE: _____

ADDRESS: _____

INDIVIDUAL _____

POSITION _____

SECTION OR DIVISION _____

PHONE NO. _____ EXT. _____

EQUIPMENT _____ DATE OF PURCHASE _____

MODEL _____ SERIAL NO. _____ ORDER NO. _____

TROUBLE REPORT:

A. Description of trouble _____

B. Has trouble been localized? _____ If so, how and where: _____

C. Instruments used and measurements taken, if any: _____

D. Is trouble intermittent? _____

E. Hours of operation prior to this trouble _____

F. Date trouble occurred _____

G. Was factory consulted by telephone or letter prior to this request? _____

If so, give date and person to whom directed: _____

H. Additional Comments: _____

When trouble develops requiring factory assistance, complete this form and send to:

Polarad Electronics Corporation
43-20 34th Street
Long Island City 1, New York
ATTENTION: Service Department

After this report has been analyzed by the Service Department, you will be notified when a field service engineer will call on you to make the necessary repairs. If your trouble can best be corrected at the factory, we will so notify you with instructions and authorization for returning the equipment.

NO EQUIPMENT MAY BE RETURNED TO THE FACTORY WITHOUT WRITTEN AUTHORIZATION

THESE ARE POLARAD REPRESENTATIVES IN THE UNITED STATES AND THROUGHOUT THE WORLD

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Decatur 2-8000

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Atlanta 5, Ga.
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Winston-Salem, N.C.
Winston-Salem 4-0750

Murphy and Cota
1220 Edgewater Drive
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Garden 4-2167

Murphy and Cota
Lane Plaza
250 5th Avenue, East
Huntsville, Ala.

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West Newton, Mass.
Bigelow 4-4832

George Gregory Associates
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Atwater 8-2900

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Ridgeway 4-3676

Eastern Associates
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Juniper 9-0100

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